MATHEMATICS 24

Examples of Students' Responses

Classroom
Assessment
Materials

MATHEMATICS 24

EXAMPLES OF STUDENTS' RESPONSES

C L A S S R O O M
A S S E S S M E N T
M A T E R I A L S

Alberta
EDUCATION

Introduction

Purpose

The purpose of this document is to provide teachers, students, parents, and administrators with examples of students' responses that illustrate the provincial standards expected of students who complete Mathematics 24.

Contents

For each of the components, the *Examples of Students' Responses* document contains
- the student task
- the scoring criteria to be used by teachers to evaluate their students' work (these criteria can also be found in the *Teacher Manual*)
- examples of students' responses at each criteria "level"
- commentaries that illustrate and explain how the scoring criteria fit each response.

Each student response in this document is reproduced as it appeared in the assessment; that is, in the students' own handwriting.

Selection of Examples

The students' responses in this document were selected from those produced during the pilot testing of the Classroom Assessment Materials Project in May and June of 1996. A committee composed of Mathematics 24 teachers from different parts of the province reviewed and validated the assessments and scoring criteria, then selected students' responses.

These examples of students' work illustrate the provincial standards for students who complete Mathematics 24.

Considerations

Please note that
- the examples presented illustrate specific standards (scoring criteria), but are not necessarily typical of the responses submitted.
- the selected responses represent only a few of the possible approaches to each task. None of the examples is intended to serve as a model of a particular approach.
- you should consider each student example in light of the constraints of the assessment situation. Under assessment conditions, most students are able to prepare responses that must be considered as first draft only.

Contents

In addition to this *Examples of Students' Responses,* the Mathematics 24 Classroom Assessement Materials includes a complete set of *Student Materials* and a *Teacher Manual* in separate booklets.

Mathematics 24

End-Of-Course Exam

- *Written Response 1*
- *Written Response 2*
- *Written Response 3*
- *Written Response 4*

End-Of-Course Exam

- Written Response 1
- Written Response 2
- Written Response 3
- Written Response 4

Mathematics 2.0

Written Response 1: Student Task and Solution

(5 marks) **1.** Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

Solution

$150 \times \$11.75 =$ **$1 762.50 before deductions**

b. Calculate Janice's monthly take-home pay.

Solution

Deductions are 18% of $1 762.50 or $317.25

Monthly take-home = gross − deductions = $1 762.50 − $317.25

Monthly take-home pay is $1 445.25

c. Janice has to pay off her five-year student loan at $214.50 per month. She wants to pay no more than one third of the rest of her paycheque for her rent. What is the **maximum** monthly rent that she can afford?

Solution

Student loan is taken off first, so $1 445.25 − $214.50 is left

This is $1 230.75, and so the maximum rent is one third of this, or $410.25.

Janice can afford a maximum of $410 monthly for rent

Task-Specific Scoring Criteria for Written Response 1

Scale score	Criteria
5	Complete answer, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	Complete answer to all parts, but with minor procedural errors present in one of the three parts. Incorrect final answers must be reasonable, but the communication may lack some clarity.
3	**Either** a complete answer to all parts, but with minor procedural errors present in one or more of the three parts. Incorrect final answers may be unreasonable, and the communication may lack some clarity; **or** a complete, correct answer to parts a. and b., with part c. started, but little progress made in part c.
2	**Either** correct answers to parts a. and b., with or without supporting detail shown, followed by a blank part c.; **or** an answer showing a strategy that could be used to answer the full question, but that shows little accuracy in carrying out the strategy.
1	**Either** a correct answer to any single part, with or without supporting detail; **or** an answer showing a significant step in the solution process, such as the relationship between gross and take-home pay, or the use of the one third factor for rent, or a similar sized step.
0	**Either** off-topic; **or** an incorrect answer to a single part, with no supporting detail; **or** a blank paper.

Written Response 1: Student Responses

This response would receive a score of	**5**

Scoring Criteria

- Complete answer, with supporting detail shown. Final answers are correct, and the communication is readily understandable.

(5 marks)   1. Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

$$11.75 \times 150 = 1762.5$$

b. Calculate Janice's monthly take-home pay.

$$1762.5 \times .18 = 317.25$$
$$317.25 - 1762.50 = 1445.25$$

c. Janice has to pay off her five-year student loan at $214.50 per month. Of the rest of her paycheque, she wants to pay no more than one third for her rent. What is the maximum monthly rent that she can afford?

$$1445.25 - 214.5 = 1230.75$$
$$1230.75 \div 3 = 410.25$$
$$\$ 410$$

Commentary

This response receives a score of 5 because the student

- correctly calculates the gross pay before deductions and the take-home pay. There is sufficient supporting detail shown to justify the values of $1 762.50 for gross pay, and of $1 445.25 for take-home pay. The lack of dollar signs and the writing of 317.25 – 1 762.50 = 1 445.25, instead of $1 762.50 – $317.25 = $1 445.25, can both be excused as editorial slips that would have been corrected in an assignment, as opposed to an exam situation.
- correctly calculates the maximum rent in three steps. First the student loan repayment is taken off the take-home pay, and then the factor one-third is written as a division by 3. Finally, the rent is rounded to the nearest dollar. The response would have been better with a few written words in support, but the method of calculation and the final answers are very clearly shown by the arrangement of the numbers on the different lines of the response.

This response would receive a score of **4**

Scoring Criteria

- Complete answer to all parts, but with minor procedural errors present in one of the three parts. Incorrect final answers must be reasonable, but the communication may lack some clarity.

(5 marks)   1. Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

$$11.75 \times 150 = \$1762.50$$

b. Calculate Janice's monthly take-home pay.

$$1762.5 \times 15 = 264.38$$

$$\begin{array}{r} 1762.5 \\ -\ 264.38 \\ \hline 1498.12 \end{array}$$

1498.12 is total take home pay

c. Janice has to pay off her five-year student loan at $214.50 per month. Of the rest of her paycheque, she wants to pay no more than one third for her rent. What is the maximum monthly rent that she can afford?

$$1498.12 - 214.5 = 1283.62$$

$$1283.62 \times .33 = \$423.59$$

$\$423.59$ is maximum monthly Rent

Commentary

This response receives a score of 4 because the student

- correctly calculates the gross pay before deductions. There is sufficient supporting detail shown to justify the values of $1 762.50 for gross pay.
- shows an understanding of percentage deductions, but uses 15% (written as 15) instead of 18% in the calculation of take-home pay.
- incorporates the incorrect take-home pay into a logical calculation of the maximum rent in two steps. First, the student loan repayment is taken off the take-home pay, and then the factor one-third is written as a multiplication by the decimal approximation 0.33. The response would have been better with a more precise decimal representation of the fraction one-third, but the method of calculation and the final answer are clearly expressed, and give an answer that is reasonable. The correct answer for maximum monthly rent is $410, and the student calculates a rent of $423.59, which is reasonably close to the correct answer.

This response would receive a score of **3**

Scoring Criteria

- A complete, correct answer to parts a. and b., with part c. started, but little progress made in part c.

(5 marks)   1. Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

$$11.75 \times 150 = \$1'762.50 \text{ monthly}$$

b. Calculate Janice's monthly take-home pay.

$$1762.50 \times .18 = 317.25$$

$$317.25 - 1762.50 = \underline{1445.25}$$

c. Janice has to pay off her five-year student loan at $214.50 per month. Of the rest of her paycheque, she wants to pay no more than one third for her rent. What is the maximum monthly rent that she can afford?   4290

$$214.50 \times 1 \div 3 = \underline{71.50}$$

Commentary

This response receives a score of 3 because the student

- calculates the correct gross income before deductions, including showing the supporting detail of $11.75 multiplied by 150 to obtain the $1 762.50 answer.
- distinguishes between the amount deducted from the paycheque (correctly calculated as $317.25) and the take-home pay. The writing of 317.25 – 1 762.50 = 1 445.25, instead of $1 762.50 – $317.25 = $1 445.25, can be excused as an editorial slip that would have been corrected in an assignment, as opposed to an exam situation.
- shows some detail to support the correct answers to both part a. and part b.
- makes a small step towards the maximum rent by including the idea of dividing a dollar amount by 3 to work out one-third of something, but chooses one-third of the student loan payment, rather than one-third of the take-home pay. The final answer of $71.50 for monthly rent is clearly unreasonable.

Other responses receiving a score of 3 are of very different character. These responses have errors in the computations in parts a. and b., together with a calculation in part c. that involves subtraction of student loan payments and taking one-third of what is left, but that leads to a maximum rent that is either very low (less than $200) or very high (more than $1 000).

This response would receive a score of	**2**

Scoring Criteria

- Correct answers to parts a. and b., with or without supporting detail shown, followed by a blank part c.

(5 marks)   **1.** Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

$$\$11.75 \times 150 = \$ 1762.50$$

b. Calculate Janice's monthly take-home pay.

$$\$ 1762.50 - 18\% (\$317.25)$$

$$= \$ 1445.25$$

c. Janice has to pay off her five-year student loan at $214.50 per month. Of the rest of her paycheque, she wants to pay no more than one third for her rent. What is the maximum monthly rent that she can afford?

Commentary

This response receives a score of 2 because the student

- calculates the correct gross income before deductions, including the supporting detail of $11.75 multiplied by 150 to obtain the $1 762.50 answer.
- distinguishes between the amount deducted from the paycheque (correctly calculated as $317.25) and the take-home pay. The expression $1 762.50 – 18%($317.25) strictly speaking is $1 705.40, but the interpretation of the bracketed $317.25 as 18% of $1 762.50 is easy to make from the response.
- shows some detail to support the correct answers to both part a. and part b.
- leaves part c. blank.

Even if no supporting detail had been shown in part a. and in part b., the response would still receive the same score of 2.

Other responses receiving a score of 2 are of very different character. These responses have errors in the computations in parts a. and b., together with a calculation in part c that involves combining two operations, and that leads to a maximum rent that is either very low (less than $200) or very high (more than $1 000).

This response would receive a score of **1**

Scoring Criteria

- A correct answer to any single part, with or without supporting detail.

(5 marks) 1. Janice graduated from school and found a job paying $11.75 per hour for 150 hours of work per month. She calculated that she had 18% of her salary deducted from her monthly paycheques.

a. Calculate Janice's gross income before deductions.

$11.75 \times 150 = 1762.50$

b. Calculate Janice's monthly take-home pay.

$1762.50 \times .18 = 317.25$

c. Janice has to pay off her five-year student loan at $214.50 per month. Of the rest of her paycheque, she wants to pay no more than one third for her rent. What is the maximum monthly rent that she can afford? $214.50 \times 60 = 12870$

Commentary

This response receives a score of 1 because the student

- calculates the correct gross income before deductions, including showing the supporting detail of $11.75 multiplied by 150 to obtain the $1 762.50 answer.
- confuses the amount deducted from the paycheque (correctly calculated as $317.25) and the take-home pay.
- picks two numbers $214.50 and 60 at random from the information given in part c., and combines them by multiplication, which is not the sequence of operations needed to calculate the maximum rent payable.

Even if no supporting detail had been shown in part a., the response would still receive a score of 1.

Written Response 2: Student Task and Solution

(5 marks) **2.** The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked on it, is found below.

Map of Northern Alberta
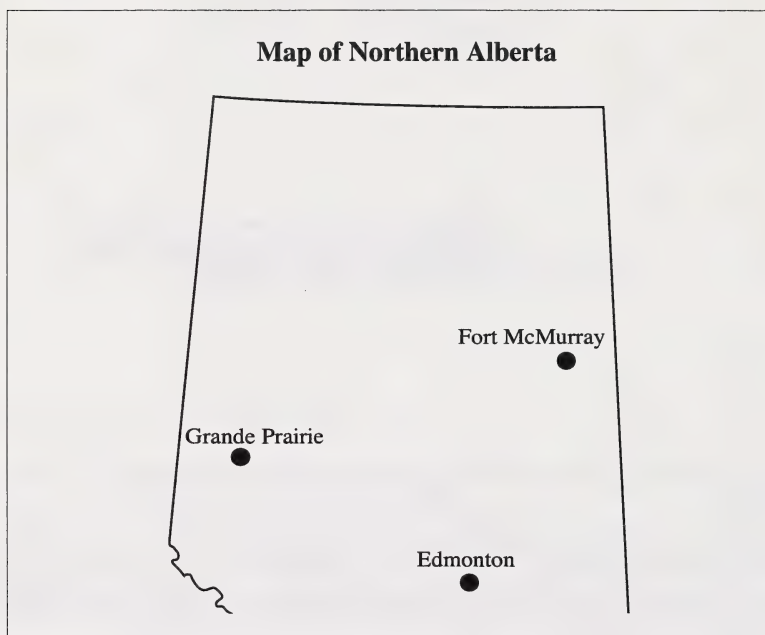
a. How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

Solution

Direct route: 720 km

Via Edmonton: 460 km + 445 km = 905 km

Distance saved by direct route = 905 km – 720 km = **185 km**

b. If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

Solution

Time on direct route = (720 km)/(90 km/h) = 8.00 h

Time via Edmonton = (905 km)/(100 km/h) = 9.05 h

Time saved = 9.05 h − 8.00 h = **1.05 h or 1 h 3 min or 63 min**

Task-Specific Scoring Criteria for Written Response 2

Scale score	Criteria
5	Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	Complete answer to both parts but with minor errors present. Final answers must be reasonable, but the communication may lack some clarity. Included in the minor errors is the use of the 100-minute hour for conversion from hours to minutes.
3	**Either** a complete and correct answer to part b., starting from an answer to part a. that shows no understanding of map reading; **or** a complete answer to both parts, with procedural errors present. Final answers are sometimes unreasonable, and the communication lacks clarity.
2	**Either** a complete and correct answer to part a., with no effective work on part b.; **or** an answer containing major procedural errors, but that shows a strategy that can be used to answer both parts of the question completely.
1	**Either** a correct answer to either part, with no supporting detail; **or** a significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, reading the distance chart, using the connections among speed, distance, and time, and recognizing the difference between direct and indirect distances between Grande Prairie and Fort McMurray.
0	**Either** off-topic, **or** an incorrect answer to part a., with no supporting detail; **or** a blank paper.

Written Response 2: Student Responses

This response would receive a score of	**5**

Scoring Criteria

- Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.

(5 marks) 2. The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked on it, is found below.

Map of Northern Alberta

Fort McMurray
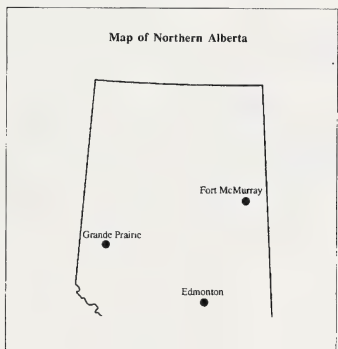
Grande Prairie

Edmonton

a. How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

you would Save 185 km

GP - FM = 720

GP - ed = 460 +445 = 195

b. If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

90 Km/h   100

720 km   905 = 9.05 hrs

90 = 720 = 8 hrs

The amount of TIme issaved is 1.05 hrs

Commentary

This response receives a score of 5 because the student

- calculates 185 km for the distance saved by the direct route, together with sufficient support to make the response convincing. The layout is not of the highest quality, but allowance can be made for poor handwriting and for time constraints.
- calculates the time saved as 1.05 h, showing the difference between times of 9.05 h via Edmonton and 8.00 h by the direct route. No attempt was made to convert the decimal parts of an hour into minutes, so the student is presumed to know that the time saved is 1.05 h and not 1:05 (1 hour and 5 minutes).

This response would receive a score of   **4**

Scoring Criteria

- Complete answer to both parts but with minor errors present. Final answers must be reasonable, but the communication may lack some clarity. Included in the minor errors is the use of the 100-minute hour for conversion from hours to minutes.

(5 marks)   2. The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked off it, is found below.

Map of Northern Alberta

Fort McMurray ●

Grande Prairie ●
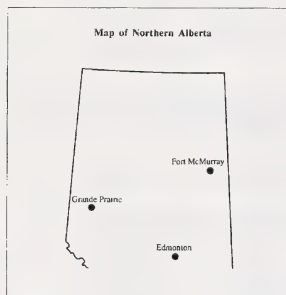
Edmonton ●

a. How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

$$720$$
$$460 + 445$$
$$905$$
$$= 185 \text{ km}$$

b. If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

$$9 \times 100$$

90 hmh + 100 9h
720
900

$$900 \div 100 = 9h$$
$$20 \div 100 = 5 \text{min}$$ .125
$$9h + 5\text{min} = 9.05h$$ $8h - 9h \ 5\text{min}$
$$90 \div 720 = 8h$$

you would save 1h and 5min

Commentary

This response receives a score of 4 because the student

- calculates 185 km for the distance saved by the direct route, together with some support to make the response plausible. More details could have been given to enhance the clarity of the response.
- calculates the time saved as 1.05 h, showing the difference between times of 9.05 h via Edmonton and 8.00 h by the direct route. Here the student explicitly used the 100-minute hour with the equation 9 h + 5 min = 9.05 h (enclosed in the square box on the left, near the bottom).

The error with the 100-minute hour alone is sufficient to reduce the score from 5 to 4, even if the layout, particularly in the first part, had been of higher quality.

This response would receive a score of **3**

Scoring Criteria

- A complete answer to both parts, with procedural errors present. Final answers are sometimes unreasonable, and the communication lacks clarity.

(5 marks) 2. The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked on it, is found below.

Map of Northern Alberta

Fort McMurray ●

Grande Prairie ●
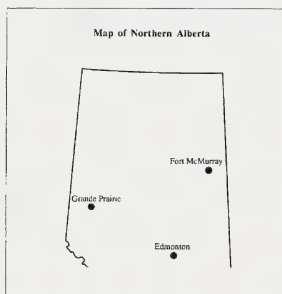
Edmonton ●

a. How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

G. Prairie to Fort McMurray. | G.P to Edmonton to F McMurray.
720 Kilometres | 905 Kilometres

$$\begin{array}{r} 905 \\ -720 \\ \hline = 185 \end{array}$$ They save 185 Kilometres going direct

b. If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

direct
90 km/h ÷ 720 = 0.13
13 hours.

Through Edmonton

100 km/h ÷ 905 = 0.11
11 hours

2 hours are saved by going 100 km/h via ~~through~~ Edmonton

Commentary

This response receives a score of 3 because the student:

- correctly calculates the distance saved as 185 km, the difference between the 720 km of the direct route and the 905 km via Edmonton.
- uses the formula $\text{time} = \dfrac{\text{speed}}{\text{distance}}$ instead of $\text{time} = \dfrac{\text{distance}}{\text{speed}}$ in the second part. When these incorrect formulas result in the answers 0.13 and 0.11, the student changes these to 13 h and 11 h so that the difference is a more reasonable 2 h, instead of the 0.02 h that follows from the use of the incorrect formula.

This response would receive a score of	**2**

Scoring Criteria

- A complete and correct answer to part a., with no effective work on part b.

(5 marks) 2 . The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked on it, is found below.

Map of Northern Alberta

Fort McMurray

Grande Prairie
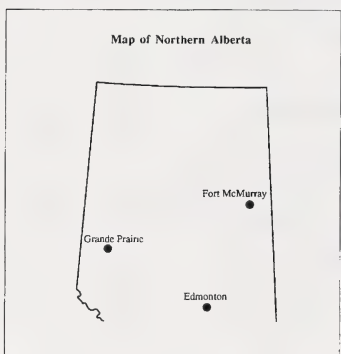
Edmonton

a . How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

GP to EDm 460k + EDm to GtM 445
= 905 km - 720 k = 185 K
distance saved 185k   185

b . If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

2 h

Commentary

This response receives a score of 2 because the student

- correctly calculates the distance saved as 185 km, the difference between the 720 km of the direct route and the 905 km via Edmonton.
- writes an answer of 2 h for the time saved, with no supporting statements or formulas given.

Other responses receiving a score of 2 will appear very different from this. These responses involve the subtraction of incorrect distances in the first part, together with a subtraction of two wrongly calculated times in the second part.

This response would receive a score of **1**

Scoring Criteria

- A significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, reading the distance chart, using the connections among speed, distance, and time, and recognizing the difference between direct and indirect distances between Grande Prairie and Fort McMurray.

(5 marks) 2. The following table shows the kilometres between three major cities in Alberta.

From/To	Grande Prairie	Fort McMurray	Edmonton
Grande Prairie	0	720	460
Fort McMurray	720	0	445
Edmonton	460	445	0

The map of northern Alberta, with the three cities marked on it, is found below.

Map of Northern Alberta

Fort McMurray
Grande Prairie
Edmonton
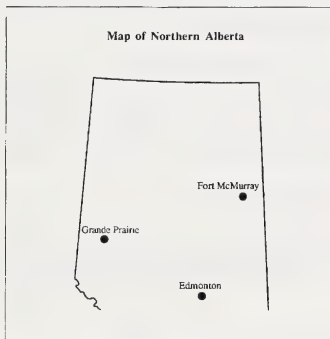
a. How much **distance** is saved in travelling from Grande Prairie to Fort McMurray by the direct route, rather than going through Edmonton?

275 kilometers is saved

b. If a car can average 90 km/h when travelling by the direct route, and average 100 km/h going through Edmonton, how much **time** is saved by travelling by the direct route?

$720 \div 90 = 8$
$720 + 460 = 1180$
$1180 \div 100 = 12$
$12 - 8 = \textcircled{4} \text{hours is saved}$

Commentary

This response receives a score of 1 because the student

- gives an unsupported incorrect answer for the difference in distance.
- completes one significant step in the calculation of 8 h (720 ÷ 90) in the first line of the second part. There is no reference made to this being the time for the direct route. In addition, there is a second significant step made in the subtraction of two times (12 h and 8 h) for the time saving. The distance of 1 180 km refers to the distance between Grande Prairie and Edmonton via Fort McMurray, so the strategy used would not find the time difference being asked for.

Either one of these significant steps is sufficient for a score of 1; on the other hand, there is insufficient cohesion in the response to the second part to make the response merit a score of 2.

Written Response 3: Student Task and Solution

(5 marks)   **3.** Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1 147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1 476.25, and made 9 bank machine withdrawals totalling $475.00.

    a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

Solution

Opening balance:	$725.90
Deposits:	$1 147.78 + $1 147.78 + $561.20 = $2 856.76
Withdrawals:	$1 476.25 + $475.00 = $1 951.25
Closing balance	= opening balance + deposits – withdrawals
	= $725.90 + $2 856.76 – $1 951.25

Closing balance is $1 631.41 before service charges

    b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

Solution

Service charges are 17×0.60 for the cheques and 9×0.35 for the bank machine withdrawals or $13.35 in total

Final bank balance	= closing balance – service charges
	= $1 631.41 – $13.35, or $1 618.06

His final bank balance = $1 618.06

Task-Specific Scoring Criteria for Written Response 3

| Scale score	Criteria
5	Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	Complete answer to both parts, but with minor procedural errors present. Final answers may be incorrect, but must be reasonable, and the communication may lack some clarity.
3	**Either** an answer to part a. or part b. that is complete and correct, with supporting detail shown, and communicated in a readily understandable form; **or** a complete answer to both parts of the question that has one major error or many minor errors present, but that shows an understanding of the relationship among opening and closing balances, the total deposits, the cheques and withdrawals, and the bank service charges. Final answers, if given, are often unreasonable.
2	**Either** an answer to part a. that is complete with supporting detail shown. Final answers may be incorrect, and the communication may lack some clarity; **or** an answer to either part of the question that has one major error or many minor errors present, but that shows some understanding of the relationships among opening and closing balances, the total deposits, the cheques and withdrawals, and the bank service charges. Final answers, if given, are often unreasonable. **or** a supported answer to part b. that follows from an unsupported part a. answer.
1	**Either** a correct answer to either part, with no supporting detail; **or** a significant start made to the solution of the problem. Significant starts include, but are not limited to, adding deposits to the opening balance, subtracting withdrawals, cheques or bank charges from the opening balance, calculating the cheque charges or calculating the bank machine charges.
0	**Either** off-topic; **or** an incorrect answer to any part, with no supporting detail; **or** a blank paper.

Written Response 3: Student Responses

This response would receive a score of	**5**

Scoring Criteria

- Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.

(5 marks) 3. Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1476.25, and made 9 bank machine withdrawals totalling $475.00

a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

```
 $1147.78              $1476.25
  1147.78              +475.00
   561.20              1951.25
 $2856.76            TOTAL WITHDRAWLS .
 TOTAL DEPOSIT
 $2856.76             $3582.66
  +25.90            - 1951.25
 $3582.66            $1631.41  GEORGE'S BALANCE
 TOTAL IN BANK.
```

b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

```
            0.60
          × 17
            4 20
          0 600
          10.20              $10.20
                           +  3.15
        A                   $13.35
        0.85               SERVICES CHARGES
      ×   9
        3.15
            $1631.41
          -   13.35
            $1618.06
          FINAL BALANCE .
```

Commentary

This response receives a score of 5 because the student

- correctly calculates the balance before service charges, the service charges, and the final balance after service charges. Each calculation is clearly labelled as "total deposit," "total in bank," "total withdrawls," making the communication very clear and easy to follow.
- even includes arithmetic details, as it is obvious that a calculator is not being used. These arithmetic details would be omitted by any student who uses a calculator, but the numbers to be added and subtracted must still be recorded for a response to merit a score of 5.

This response would receive a score of   **4**

Scoring Criteria

- Complete answer to both parts, but with minor procedural errors present. Final answers may be incorrect, but must be reasonable, and the communication may lack some clarity.

(5 marks)   3. Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1476.25, and made 9 bank machine withdrawals totalling $475.00

a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

$$
\begin{array}{r} 1147.74 \\ + 561.20 \\ \hline 1708.98 \ \text{deposited} \\ + 725.90 \\ \hline 2434.88 \end{array}
$$

$$
\begin{array}{r} 2434.88 \\ -1476.25 \\ \hline 958.63 \\ -475 \\ \hline \$483.63 \end{array}
$$

His balance is $483.63

b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

$$17 \times 60 = \$10.20$$
$$35 \times 9 = \$3.15$$
$$\$13.35$$

$$\$483.63 - 13.35 = \$470.28$$

his balance is $470.28

Commentary

This response receives a score of 4 because the student

- uses a strategy of adding deposits to Jorge's original balance, and then subtracting both cheques written and bank machine withdrawals. However, only one of the paycheques of $1 147.78 was included in the deposits. The final answer to the first part then is $483.63, instead of the correct value of $1 631.41.
- takes the incorrect response to the first part, calculates the correct service charges of $13.35, and subtracts these to obtain a consistent final balance of $470.28.

Only one error was made, and both final answers are consistent with the omission of one of the two paycheques.

This response would receive a score of 3

Scoring Criteria

- A complete answer to both parts of the question that has one major error or many minor errors present, but that shows an understanding of the relationship among opening and closing balances, the total deposits, the cheques and withdrawals, and the bank service charges. Final answers, if given, are often unreasonable.

(5 marks) 3. Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1476.25, and made 9 bank machine withdrawals totalling $475.00

a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

his balance at the end of the
month is $ 3582.66

(work done) $1147.78
× 2
$2295.56 + $561.20 = $2856.76
+ 725.90
$3582.66

b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

① Cheques = $10.20
Bank machine = $ 3.15   total = $13.35

② $ 3582.66
1476.25
475.00
− 13.35

The money that he will have
In the bank at the end
of the month will be

$ 1618.06

Commentary

This response receives a score of 3 because the student

- correctly calculates the final balance of $1 618.06 after the service charges have been taken out. This final balance is supported with a calculation of the service charges as $13.35, and the subtraction of the cheques and the bank machine withdrawals ($1 476.25 and $475.00 respectively) from the $3 582.66 given as an answer to the first part.
- makes a major error in confusing bank debit items with service charges. The bank balance of $3 582.66 reflects the sum of opening balance and all three credit items, and assumes that every cheque was written, and every bank machine withdrawal was made on the day the bank statement was drawn up. This assumption is not valid.

Other responses receiving a score of 3 will appear very different from this. These other responses will have one of the two parts of the question correct, and the response to the other part will show little or no significant progress.

This response would receive a score of **2**

Scoring Criteria

- An answer to either part of the question that has one major error or many minor errors present, but that shows some understanding of the relationships among opening and closing balances, the total deposits, the cheques and withdrawals, and the bank service charges. Final answers, if given, are often unreasonable.

(5 marks)   3. Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1476.25, and made 9 bank machine withdrawals totalling $475.00

a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

$$1147.78$$
$$1147.78$$
$$+\ 561.20$$
$$725.90$$
$$-3581.76$$
$$1476.25$$
$$\$2105.51\ \text{BALance}$$

b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

$$.60 \times 17 = 1620$$
$$.35 \times 9 = 3.19$$

$$10.20$$
$$+3.19$$
$$\overline{13.41}\ \text{Servic Charger}$$

$$2105.51$$
$$10.20$$
$$+\ 3.19$$
$$\overline{2118.86}\ \text{Final Bank Balance}$$

Commentary

This response receives a score of 2 because the student

- shows, in the first part, a strategy of taking the opening balance, adding the two paycheques and the tax refund cheque, and subtracting the cheques written. However, the $475.00 in bank machine withdrawals were omitted from the computation.
- makes the error of adding the service charges as a credit to calculate the closing balance, instead of subtracting them as a debit. Because of this error, it does not matter that the charges were calculated correctly as $10.20 and $3.15 in the centre of the page. The calculation of $13.41 for service charges at the left edge of the response, likewise, was ignored.

This response would receive a score of   **1**

Scoring Criteria

- A significant start made to the solution of the problem. Significant starts include, but are not limited to, adding deposits to the opening balance, subtracting withdrawals, cheques or bank charges from the opening balance, calculating the cheque charges or calculating the bank machine charges.

(5 marks)   **3.** Jorge is looking at his monthly bank statement. His opening balance at the beginning of the month was $725.90. He deposited two paycheques, each for $1147.78, and one tax refund cheque for $561.20. He wrote 17 cheques, totalling $1476.25, and made 9 bank machine withdrawals totalling $475.00

   a. Before any service charges were taken out, what was Jorge's balance at the end of the month?

$$\$905.51$$

   b. The service charges are 60 cents for each cheque written and 35 cents for each bank machine withdrawal made. There are no service charges for deposits. How much did Jorge pay in service charges, and what was his final bank balance at the end of the month?

$$\$10.20 + \$3.15$$
$$\$13.35$$

Commentary

This response receives a score of 1 because the student

- correctly calculates the service charges as $13.35, even though there is no attempt at communicating that the $10.20 refers to cheque-writing charges and the $3.15 refers to bank machine charges.
- writes an incorrect answer to the first part with no support for the answer at all.

Written Response 4: Student Task and Solution

(5 marks)   **4.** The calculation to be done is $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$.

     a. Use your calculator to find the result, and explain how you did this calculation on your calculator.

Your explanation can be

either
a listing, in order, of the keystrokes used

or
an explanation of the reasoning used in doing the calculation.

Solution

1. **Using a scientific calculator:**

$21.6 \div (12.3 \times (14.5 - 7.9)) =$ giving a **final answer of 0.266075**

2. **Using a four-function calculator:**

$14.5 - 7.9 = \times 12.3 = $ M+, putting 81.18 into the memory

$21.6 \div$ MR $= $, giving a **final answer of 0.266075**

     b. Estimate the result, and indicate using words, charts, or formulas how you did the estimate.

Solution

Numerator is about 22, while the denominator is about 84 (12 times 7)

Final answer is about 0.25 **(friendly fraction 20/80 is close to 22/84)**

Task-Specific Scoring Criteria for Written Response 4

Scale score	Criteria
5	Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.
4	Complete answer to both parts, but may have minor errors present. **Either** final answers may be incorrect, and the communication may lack some clarity; **or** final numerical answers to both parts are correct, but inadequately supported.
3	**Either** a complete answer that has one major error **or** many minor errors present, but that indicates the estimate, the calculation, the order of operations, and the written explanations in support; **or** final numerical answers to both parts are correct, but unsupported by any written explanation; **or** a correct numerical answer to part a. with full supporting detail, but no valid estimation process shown in part b.
2	**Either** a reasonable estimate to part b., with supporting detail; **or** a correct numerical answer to part a., with no supporting detail in part a. and no estimate in part b.; **or** a complete answer that has one major error **or** many minor errors present, but that indicates some of the processes of estimation, calculation, selection of the order of operations, and includes some written explanations in support.
1	**Either** a reasonable estimate to part b., with no supporting detail; **or** a significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, attempts at explaining estimates, and awareness of the order of operations in the calculation strategy used.
0	**Either** off-topic; **or** an unreasonable estimate in part b., with no supporting detail; **or** a blank paper.

Written Response 4: Student Responses

This response would receive a score of	**5**

Scoring Criteria

- Complete answer to both parts, with supporting detail shown. Final answers are correct, and the communication is readily understandable.

(5 marks)   4. The calculation to be done is $\frac{216}{12.3 \times (14.5 - 7.9)}$

a. Use your calculator to find the result, and explain how you did this calculation on your calculator

Your explanation can be
either
a listing, in order, of the keystrokes used
or
an explanation of the reasoning used in doing the calculation.

1) write out equasion
$$\frac{21.6}{12.3 \times (14.5 - 7.9)}$$
2) find the brackets answer $14.5 - 7.9 = 6.6$
3) rewrite the question $\frac{21.6}{12.3 \times 6.6}$
4) answer the lower part of the question $12.3 \times 6.6 = 81.18$

5) rewrite the question $\frac{21.6}{81.18}$
6) Solve the question with the new equasion $\frac{21.6}{81.18} = 0.2660753$
7) Round your answer to 0.27

b. Estimate the result, and indicate using words, charts, or formulae how you did the estimate.

1) Round every number in the equasion, either up or down depending on the number behind the decimal 22 $12 \times (15 - 8)$ $15 - 8 = 7$
2) subtract the brackets $\frac{22}{12 \times 7}$ $\frac{22}{84} = 0.26$
3) Rewrite the equasion with the new values
4) divide the final frachion to get the final answer

Commentary

This response receives a score of 5 because the student

- provides a valid estimation process, using appropriate rounding procedures and the correct order of operations, to obtain the fraction $\frac{22}{84}$. Strictly speaking, the estimate should have been continued, using the friendly fraction $\frac{20}{80}$ or $\frac{22}{88} = \frac{1}{4}$, but using the calculator for a final value of 0.26 still merits full credit. The estimation process is well documented by written comments such as "Round every number either up or down", in the first part.

- provides a detailed explanation of the order of operations needed to use an ordinary four-function calculator to complete the calculation. All intermediate values, such as the 81.18, are clearly recorded at the appropriate step in the process, and the reader can check each line as the calculation proceeds.

This response would receive a score of	**4**

Scoring Criteria

- Complete answer to both parts; final numerical answers to both parts are correct, but inadequately supported.

(5 marks) 4. The calculation to be done is $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$.

    a. Use your calculator to find the result, and explain how you did this calculation on your calculator.

    Your explanation can be
    either
    a listing, in order, of the keystrokes used
    or
    an explanation of the reasoning used in doing the calculation.

$$14.5 - 7.9 = 6.6 \times 12.3 = 81.18$$
$$21.6 \div 81.18 = 0.2661$$

The final answer is 0.2661

    b. Estimate the result, and indicate using words, charts, or formulae how you did the estimate.

$$15 - 8 = 7 \times 12 = 84$$
$$22 \div 84 = 0.26$$

To set my estimate I rounded all the decimals to whole numbers then did the calculations.

Commentary

This response receives a score of 4 because the student

- correctly calculates the estimate as $\dfrac{22}{84}$. Strictly speaking, the estimate should have been continued, using the friendly fraction $\dfrac{20}{80}$ or $\dfrac{22}{88} = \dfrac{1}{4}$, but using the calculator for a final value of 0.26 still merits full credit. Details of the estimation process are sketchy, as there is no place where it is stated that 14.5 rounds to 15, 7.9 rounds to 8, and so on.

- provides some explanation of the order of operations needed to use an ordinary four-function calculator to complete the calculation. All intermediate values, such as the 81.18, are clearly recorded at the some step in the process, but equals signs are used inappropriately in the discussion in both parts. The use of $14.5 - 7.9 = 6.6 \times 12.3 = 81.18$ is an abbreviated way of writing out the process of determining the denominator of the fraction in the second part. Similar abbreviated statements occur throughout the discussion, and these statements detract from the clarity of the response.

This response would receive a score of   **3**

Scoring Criteria

- A correct numerical answer to part a., with full supporting detail, but no valid estimation process shown in part b.

(5 marks)   4.   The calculation to be done is $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$.

a.   Use your calculator to find the result, and explain how you did this calculation on your calculator.

Your explanation can be
either
a listing, in order, of the keystrokes used
or
an explanation of the reasoning used in doing the calculation.

- Left bracket button
- 14.5 ⊟ 7.9
- Right bracket button
- ⊠ 12.3
- ⊟ 81.18
- clear
- 21.6 ⊟ 81.18
- ⊟ .266

b.   Estimate the result, and indicate using words, charts, or formulae how you did the estimate.

Answer .0015

I rounded all the numbers either up or down then did the calculations

---

Commentary

This response receives a score of 3 because the student

- writes the calculation processes for the first part completely in terms of keystrokes in a flowchart. The sequence of keystrokes works on a four-function calculator, and the provision of intermediate answers, such as 81.18, aids in the clarity of the explanation.
- provides an unreasonable estimate of .0015 for the second part, and supports the estimate with a paraphrase of the word *estimation* as being the same as *rounding*. This paraphrase may give limited support to a reasonably close estimate, but is inadequate for a poor estimate.

This response would receive a score of   **2**

Scoring Criteria

- A complete answer that has one major error **or** many minor errors present, but that indicates some of the processes of estimation, calculation, selection of the order of operations, and includes some written explanations in support.

(5 marks)   4. The calculation to be done is $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$.

a. Use your calculator to find the result, and explain how you did this calculation on your calculator.

Your explanation can be
either
a listing, in order, of the keystrokes used
or
an explanation of the reasoning used in doing the calculation.

① $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$

② $\dfrac{21.6}{12.3 \times (6.6)}$

③ $\dfrac{21.6}{81.18}$

④ $= 3.76$

b. Estimate the result, and indicate using words, charts, or formulae how you did the estimate.

$\dfrac{22}{12 \times (15 - 8)}$

$\dfrac{22}{12 \times (7)}$

$\dfrac{22}{105}$

$= 4.77$

Commentary

This response receives a score of 2 because the student

- completes a strategy of rounding in the first part and exact calculation in the second part.

- uses an effective strategy that involves calculating the quantities inside the brackets, such as $14.5 - 7.9$, first, followed by multiplying by 12.3 to obtain 81.18. However, in both parts, the response indicates a mistaken view of the concept of fraction. Instead of the fraction $\dfrac{\text{top}}{\text{bottom}}$ being calculated using top ÷ bottom, the student uses bottom ÷ top. This error occurs in both parts.

- makes a mental mathematics error of $12 \times 7 = 105$, making the estimated and exact answers very different from one another.

Other responses receiving a score of 2 appear very different from this. These responses typically have one or other part correct or nearly correct, with little attempt to explain or justify answers. The remaining part is either blank or is an unsupported incorrect number.

This response would receive a score of **1**

Scoring Criteria

- A significant start made to the solution of the problem. Examples of significant starts include, but are not limited to, attempts at explaining estimates, and awareness of the order of operations in the calculation strategy used.

(5 marks)   4. The calculation to be done is $\dfrac{21.6}{12.3 \times (14.5 - 7.9)}$.

    a. Use your calculator to find the result, and explain how you did this calculation on your calculator.

    Your explanation can be
either
a listing, in order, of the keystrokes used
or
an explanation of the reasoning used in doing the calculation.

round 21.6 to 22
round 12.3 to 12
round 14.5 to 15
round 7.9 to 8

then Solve $\dfrac{22}{12 \times (15 - 8)} = 19.5$

But if don't change any thing
you will get $\dfrac{21.6}{12.3 \times (14.5 - 7.9)} = 17.56$

    b. Estimate the result, and indicate using words, charts, or formulae how you did the estimate.

round 21.6 to 22
round 12.3 to 12
round 14.5 to 15
round 7.9 to 8

then Solve $\dfrac{22}{12 \times (15 - 8)} = 19.5$

Commentary

This response receives a score of 1 because the student

- makes a significant start by indicating that rounding all the decimals to whole numbers will give the estimate, while use of the original decimals will give the exact value.
- gives numerical answers, 19.5 and 17.56, that result from using the numbers from left to right, rather than utilising the brackets.
- fails to consider the order of operations in any way.
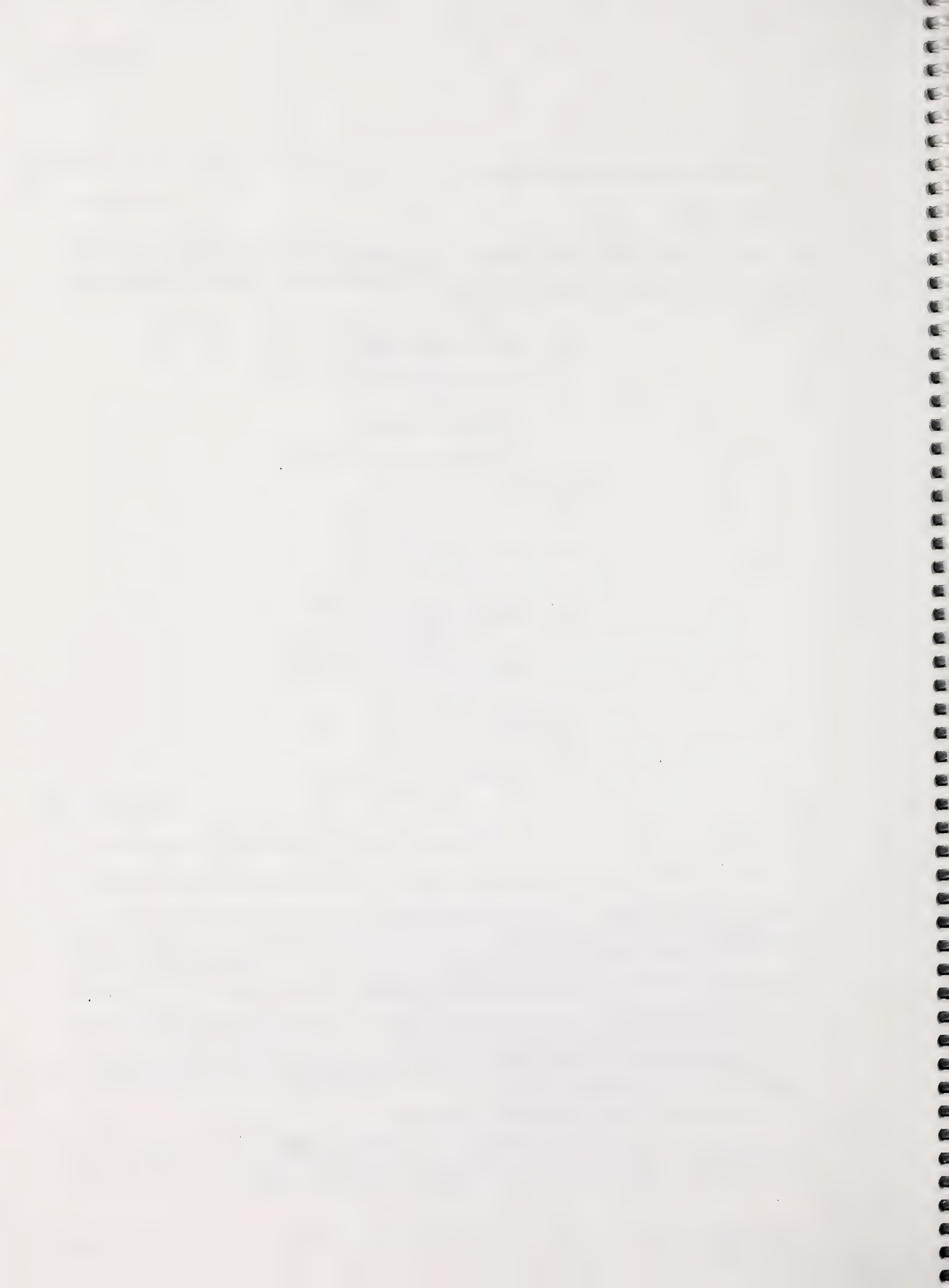
Performance Assessment

- *Task 1: Soft Drink Bargains*
- *Task 2: Operating a Car for a Year*
- *Task 3: House Floor Plans*
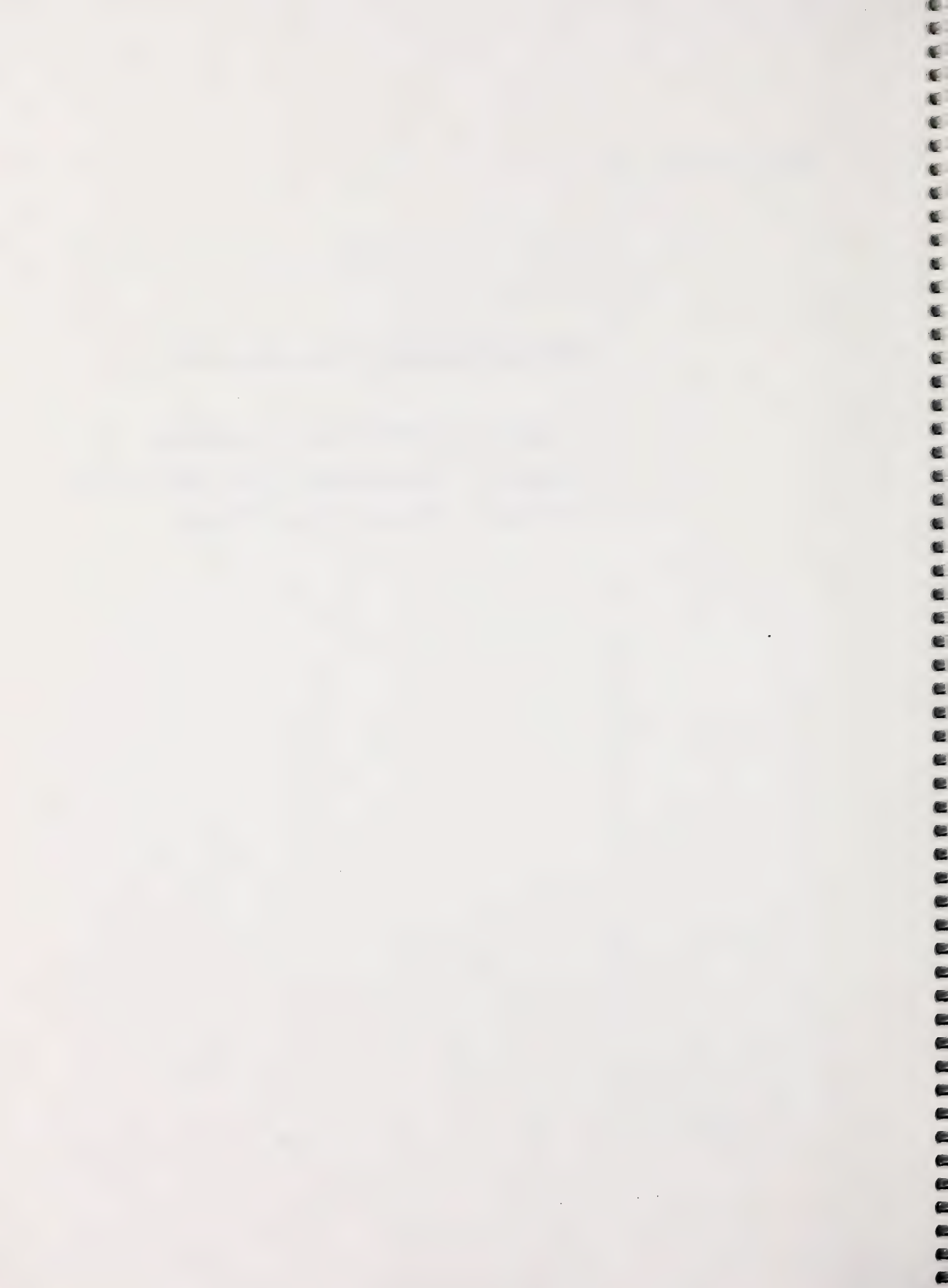
Task 1: Soft Drink Bargains
Student Task and Solution

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A	$1.19 for cup B	$1.89 for cup C

a. Use a measuring cylinder to measure the volumes of each of the cups A, B, and C.

Solution

Cup A (small) = **224 mL** ; cup B (medium) = **455 mL** ; cup C (large) = **885 mL**

These were commercial (non-metric) 8, 16, and 32-ounce cups obtained from a supermarket. These cups will vary from place to place. Varying answers will cause the answers to part b. to vary.

b. Determine the best price for each size of drink (small, medium, and large). Show your calculations.

Solution

Store Name	Price per litre for small pop	Price per litre for medium pop	Price per litre for large pop
Discount Joe	$0.85 per 350 mL or **$2.429/L**	$1.29 per 550 mL or $2.345/L	$1.69 per 900 mL or $1.878/L
Luigi's	$0.79 per 300 mL or $2.633/L	$1.09 per 500 mL or **$2.18/L**	$1.29 per 750 mL or **$1.72/L**
Taco Stand	$0.59 for cup A or $0.59 per 224 mL or $2.634/L	$1.19 for cup B or $1.19 per 455 mL or $2.615/L	$1.89 for cup C or $1.89 per 885 mL or $2.136/L

Best buys are **bolded**, with Discount Joe being the best buy for a small pop, and Luigi's being the best buys for medium and large pops.

Task-Specific Scoring Criteria for Task 1

Mathematical Content Scale

Scale score	Criteria
5	A complete and correct solution based on unit prices or volumes per dollar, and including data obtained from the measured volumes of the three cups supplied.
4	**Either** a complete and correct solution for Diamond Joe's and Luigi's based on unit prices or volumes per dollar, including measurements of the three cups supplied, but not including the measured data in the calculations for Taco Stand; **or** a complete solution, using measurements in part a. and unit prices or volumes per dollar in part b., with the solution showing some inaccuracies in measurement or calculation.
3	**Either** a complete and correct solution for Diamond Joe's and Luigi's based on unit prices or volumes per dollar, but not including any measurements of the three cups supplied; **or** a complete solution, using measurements in part a. and unit prices or volumes per dollar in part b., with the solution showing many inaccuracies in measurement and calculation; **or** a complete set of measurements in part a., together with the calculation of at least one row or column of unit prices in part b.
2	**Either** a complete set of measurements in part a., with little progress in part b.; **or** a complete set of calculations for the three unit prices or three volumes per dollar for a row or a column in part b.
1	A significant start made to the problem, such as the measurement of the volume of one cup in part a., or the calculation of one unit price or volume per dollar in part b.
0	**Either** off-topic; **or** a blank paper.

Continued

Communication Skills Scale

This scale is used **independently** of the *Mathematical Content* scale. A well-laid-out, systematic strategy with conclusions clearly stated can receive a scale score of 3, even if the comparison itself is based on data that contain gross errors in the calculations of the supporting numbers.

Scale score	Criteria
3	A clear solution that states explicitly the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a systematic, ordered manner, and includes a full concluding statement. Few, if any, gaps are left for the reader to fill in.
2	A solution that states, by implication, the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a relatively systematic manner, and may not include a full concluding statement. Some gaps are left for the reader to fill in, but the comparison methodology can be discerned.
1	An attempt has been made to communicate the comparison strategy, but nothing systematic is stated or implied. Calculations, when done, are arranged randomly, and the comparison methodology is not evident.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Performance Assessment — Task 1
Student Responses

This response would receive a score of	**5**	*for mathematical content*
and would receive a score of	**3**	*for communication skills*

Scoring Criteria

Mathematical Content

- A complete and correct solution based on unit prices or volumes per dollar, and including data obtained from the measured volumes of the three cups supplied.

Communication Skills

- A clear solution that states explicitly the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a systematic, ordered manner, and includes a full concluding statement. Few, if any, gaps are left for the reader to fill in.

Task 1: Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup *A*	$1.19 for cup *B*	$1.89 for cup *C*

a. Use a measuring cylinder to measure the volumes of each of the cups *A*, *B*, and *C*.

250mL – Small – A
425mL – medium – B
875mL – large – C

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large). Show your calculations.

	small	medium	large
Discount Joe	0.24¢/mL	0.23¢/mL	0.19¢/mL
Luigi's	0.26¢/mL	0.22¢/mL	0.17¢/mL
Taco Stand	0.24¢/mL	0.28¢/mL	0.22¢/mL

Discount Joe

small = $0.85 ÷ 350mL
= 0.0024¢ ≈ 0.24¢/mL

med = $1.29 ÷ 550mL
= 0.0023¢ = 0.23¢/mL

large = $1.69 ÷ 900mL
= 0.00019¢ = 0.19¢/mL

Luigi's

small = $0.79 ÷ 300mL
= 0.0026¢ = 0.26¢/mL

med = $1.09 ÷ 500mL
= 0.00224¢ = 0.22¢/mL

large = $1.29 ÷ 750mL
= 0.00179¢ = 0.17¢/mL

Taco Stand

small = $0.59 ÷ 250mL
= 0.00244¢ = 0.24¢/mL

med = $1.19 ÷ 425mL
= 0.0028¢ = 0.28¢/mL

large = $1.89 ÷ 875mL
= 0.0023¢ = 0.22¢/mL

Best buy = small = Discount Joe (350mL)
med = Luigi's (500mL)
large = Luigi's (750mL)

Commentary

This response receives a score of 5 for **mathematical content** *because the student*

- measures the volumes of the three cups as 250 mL, 425 mL, and 875 mL, and incorporates these volumes into the calculations.
- uses unit prices in cents per millilitre as the basis for comparison, and takes the lowest value to be the best buy. Here there is a slight error in determining the best value for the small pop, as Taco Stand is slightly better value when the third decimal place is considered (0.236 cents per millilitre, compared to 0.243 cents for Discount Joe's). However, the student here could have said that, as both were the same unit price, the larger cup (Discount Joe) provides the best buy. It is an open question whether to use the third decimal or the cup size as the tie-breaker when the unit prices are the same to two decimals. Certainly, the score of 5 is still justified here.

This response receives a score of 3 for **communication skills** *because the student*

- communicates the measurements clearly, as well as the nine calculations of unit prices.
- respects the reader by producing a summary table of unit prices, and a set of concluding statements as to the best buy for each size.

This response would receive a score of **4** for mathematical content
and would receive a score of **2** for communication skills

Scoring Criteria

Mathematical Content

- A complete solution, using measurements in part a. and unit prices or volumes per dollar in part b., with the solution showing some inaccuracies in measurement or calculation

Communication Skills

- A solution that states, by implication, the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a relatively systematic manner, and may not include a full concluding statement. Some gaps are left for the reader to fill in, but the comparison methodology can be discerned.

Task 1: Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A ~~265 mL~~	$1.19 for cup B ~~460mL~~	$1.89 for cup C ~~800mL~~

a. Use a measuring cylinder to measure the volumes of each of the cups A, B, and C.

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large).
Show your calculations.

¢ Per mL

	Discount Joe's	Luigi's	Taco Stand
Small	0.0024 ¢	0.0026 ¢	0.0022 ¢
medium	0.0023 ¢	0.0022 ¢	0.0026 ¢
Large	0.0019 ¢	0.0017 ¢	0.0024 ¢

S Cup A = 265 mL
M Cup B = 460 mL
L Cup C = 800 mL

Best Values =
 Small - Discount Joe
 medium - Discount Joe
 Large - Discount Joe

Discount Joe's is the best Prices.

Commentary

This response receives a score of 4 for **mathematical content** *because the student*

- measures the volumes of the three cups as 265 mL, 460 mL, and 800 mL, and incorporates these volumes into the calculations.
- uses unit prices in dollars per millilitre (though they are recorded as cents per millilitre) as the basis for comparison, and calculates each of the nine unit prices correctly.
- chooses Discount Joe's as the best by taking the average price per millilitre, averaged over the three sizes of pop. Discount Joe's averages 0.22 cents per millilitre, Luigi's 0.22 cents per millilitre, and Taco Stand averages 0.24 cents per millilitre. There was no consideration that a best buy decision has to be made for each size separately.

This response receives a score of 2 for **communication skills** *because the student*

- communicates the measurements clearly, as well as the results of the nine calculations of unit prices.
- respects the reader by producing a summary table of unit prices and a set of concluding statements as to the best buy for each size, but does not include an example of a division of a price by a volume to give a unit price. This gap is left for the reader to fill in.

This response would receive a score of **3** for mathematical content
and would receive a score of **3** for communication skills

Scoring Criteria

Mathematical Content

- A complete solution, using measurements in part a. and unit prices or volumes per dollar in part b., with the solution showing many inaccuracies in measurement and calculation.

Communication Skills

- A clear solution that states explicitly the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a systematic, ordered manner, and includes a full concluding statement. Few, if any, gaps are left for the reader to fill in.

Task 1: Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A	$1.19 for cup B	$1.89 for cup C

a. Use a measuring cylinder to measure the volumes of each of the cups A, B, and C.

```
A  Small cup      B Medium Pop      "Large P.P
    100mL             100m2            154m
    100 mL            100mm            100mt
  + 63mL            101 mL           100mL
    263mL             100 mL           100mL
              +       54mL             100mt
                      455 mL           100mt
                                       100mL.
                                       101 mL
                                  +    34mL
                                       944 mL.
```

I put 100mL of water in the
graduated cylinder at a time
and recorded until there was
no more liquid left in the cup.
  I then added all of the 100s of
mL together and got my answer.

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large). Show your calculations.

Discount Joe

Small pop – $0.85 ÷ 350 = 411.76 × 0.85 = 349.

medium pop – $1.29 ÷ 550 mL = 426.3 × 1.29 = 549.

Large pop – $1.69 ÷ 900 mL = 532.5 × 1.69 = 899

The best price would be the small Drink

Luigi's

small pop – $0.79 ÷ 300 mL = 379.75 × 0.79 = 300

medium pop = $1.09 ÷ 500 mL = 458.72 × 1.09 = 420

Large pop = $1.29 per 750 mL = 581.3 × 1.29 = 749

The best deal would be the medium drink.

Taco Stand.

small pop = $0.59 ÷ 263 mL = 445.76 × 0.59 = 2636

medium pop = $1.19 ÷ 455 mL = 382.35 × 1.19 = 454.9

Large Pop = $1.89 ÷ 944 mL. = 499.47 × 1.89 = 943

The best deal would be the medium pop.

Commentary

This response receives a score of 3 for **mathematical content** *because the student*

- shows the large pop volume as 944 mL, when the numbers add to 839 mL.
- calculates all nine unit prices correctly, but then uses these unit prices to determine the best size at each store, rather than the best store for each size. The method of using unit prices is still valid, but columns should be compared, and not rows.

This response receives a score of 3 for **communication skills** *because the student*

- communicates the measurements and even the measurement process clearly, as well as the nine calculations of unit prices.
- respects the reader by producing a set of concluding statements as to the size that gives the best buy at each store. The requirement that the question asked for the best **place** to buy each **size** does not detract from the clarity of the response and the score given for mathematical communication.

This response would receive a score of	**3**	for mathematical content
and would receive a score of	**2**	for communication skills

Scoring Criteria

Mathematical Content

- A complete solution, using measurements in part a. and unit prices or volumes per dollar in part b., with the solution showing many inaccuracies in measurement and calculation.

Communication Skills

- A solution that states, by implication, the basis for comparison (either dollars per litre or millilitres per dollar), shows the results of computation in a relatively systematic manner, and may not include a full concluding statement. Some gaps are left for the reader to fill in, but the comparison methodology can be discerned.

Task 1: Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A *280*	$1.19 for cup B *480 mL*	$1.89 for cup C *870*

a. Use a measuring cylinder to measure the volumes of each of the cups *A*, *B*, and *C*.

Cup A is 280 mL

Cup b is 480 mL

Cup C is 870 mL

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large). Show your calculations.

Small

Joes   .85   / 350mL

Luigis .79   / 300mL

Taco   .59   / 280mL

Joes because it holds 50mL more and is only 6¢ more expensive than Luigis.

Medium

Luigis because It hold 20mL more and is 10¢ cheaper than Taco.

Large

Discount Joes because it hold more than Luigis and Taco and is 30mL more than Taco.

Commentary

This response receives a score of 3 for **mathematical content** *because the student*

- produces a complete set of measurements and uses these in comparing the prices at different stores.
- uses estimates, rather than unit prices, as the basis of comparison. These estimates are valid in comparing pairs, but are not always valid for comparisons among three. For example, Joe's small is better value than Luigi's small, as the extra 6 cents is inexpensive for the extra 50 millilitres. However, this estimation process fails to analyze the prices at Taco Stand, whose product is far cheaper than either Joe's or Luigi's.

This response receives a score of 2 for **communication skills** *because the student*

- communicates the measurements clearly, as well as the results of the estimation process for comparison pricing.
- respects the reader by producing a set of concluding statements as to the best buy for each size, but does not include an example of the details of the estimation process being used. This gap is left for the reader to fill in, and the communication is less convincing as a result.

This response would receive a score of	**2**	for mathematical content
and would receive a score of	**1**	for communication skills

Scoring Criteria

Mathematical Content

- A complete set of measurements in part a., with little progress in part b.

Communication Skills

- An attempt has been made to communicate the comparison strategy, but nothing systematic is stated or implied. Calculations, when done, are arranged randomly, and the comparison methodology is not evident.

Task 1: Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A	$1.19 for cup B	$1.89 for cup C

a. Use a measuring cylinder to measure the volumes of each of the cups A, B, and C.

$CupA = 300 mL$

$CupB = 600 mL$

$CupC = 1100 mL$

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large). Show your calculations.

$$Cup A = .59^{\cent} \div 300 \qquad = .001^{9}$$
$$Cup B = 1.19 \div 600 = .002$$
$$Cup C = 1.89 \div 1100 = .002$$

cup C is the best value.

Commentary

This response receives a score of 2 for **mathematical content** *because the student*

- measures the volumes of the three cups as 300 mL, 600 mL, and 1 000 mL.
- starts dividing price by volume to get some idea of unit price, but the unit prices are quoted with only three decimals of a dollar per millilitre, rather than four or five. In addition, the calculation for cup A should be 0.001 97, not 0.001 as written.

This response receives a score of 1 for **communication skills** *because the student*

- leaves many gaps in the working out of the unit prices; especially without a unit (dollars or cents per millilitre) or sufficient decimal places.
- makes a giant leap from the unit prices, 0.001, 0.002 and 0.002, shown in the calculation, to the statement "cup C is the best value".

This response would receive a score of	**1**	*for mathematical content*
and would receive a score of	**0**	*for communication skills*

Scoring Criteria

Mathematical Content

- A significant start made to the problem, such as the measurement of the volume of one cup in part a., or the calculation of one unit price or volume per dollar in part b.

Communication Skills

- Insufficient evidence of communication skills.

Task 1:   Soft Drink Bargains

Ahmed had noticed that the prices of his favourite soft drink varied considerably, as did the sizes of the containers. He collected the following data on prices and sizes.

Store name	Price for small pop	Price for medium pop	Price for large pop
Discount Joe	$0.85 per 350 mL	$1.29 per 550 mL	$1.69 per 900 mL
Luigi's	$0.79 per 300 mL	$1.09 per 500 mL	$1.29 per 750 mL
Taco Stand	$0.59 for cup A	$1.19 for cup B	$1.89 for cup C

a. Use a measuring cylinder to measure the volumes of each of the cups A, B, and C.

A. .59 for 295 mL

B. 1.19 for 440 mL

C. 1.89 for 788 mL

Continued

Continued

b. Determine the best price for each size of drink (small, medium, and large).
Show your calculations.

Jou

Small   medium   Large

Luigi's

Stand

Commentary

*This response receives a score of 1 for **mathematical content** because the student*

- completes a significant start in the measurements, producing three reasonable measurements of 295 mL, 440 mL, and 788 mL for the three cups.
- makes no progress in the calculations involved in the second part. Some small step in the calculations was needed before the criteria for a score of 2 can be satisfied.

*This response receives a score of 0 for **communication skills** because the student*

- has not written a response of sufficient length for a reasonable assessment to be made.

Task 2: Operating a Car for a Year
Student Task and Solution

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

Cost category	Costs incurred
Depreciation	$2 650.00
Insurance and registration	$840.00
Tires	4 at $72.50 each
Oil changes	7 at $32.95 each
Gasoline	3 100 L at 44.9 cents/litre
Repairs	$115.00 for a tune-up
	$277.50 for brakes
Parking	$44.50 per month for 12 months
Washing	27 washes at $4.25 each
Interest on borrowed money	$1 145.00

a. What was the total cost, to Roger, of running his car for the year?

Solution

$2 650 + $840 + (4 × $72.50) + (7 × $32.95) + (3 100 × $0.449) + $115
+ $277.50 + (12 × $44.50) + (27 × $4.25) + $1 145 = **$7 588.80**

Roger's total cost = $7 588.80 for the year

b. If the price of gasoline increased to 61.5 cents/litre, how much extra would it cost Roger to run his car for the year?
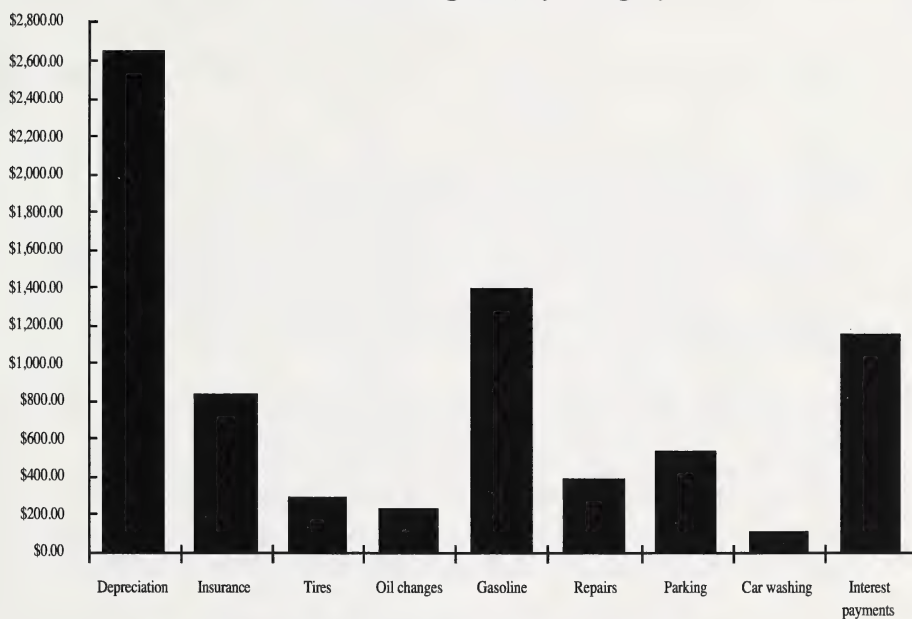
Solution

3 100 × ($0.615 − $0.449) = **$514.60 extra per year**

c. Display the budget as a graph.

Solution

Cost of Running Car, by Category

Task-Specific Scoring Criteria for Task 2

Mathematical Content Scale

Scale score	Criteria
5	Complete and correct set of answers to parts a. and b., together with a bar graph in part c. that accurately represents these answers.
4	**Either** a complete and correct set of answers to parts a. and b., together with a bar graph in part c. that reasonably represents these answers; **or** a reasonable set of answers to the numerical calculations in parts a. and b., together with a bar graph in part c. that exactly represents these answers.
3	**Either** a complete and correct set of answers to parts a. and b., with little significant progress on the bar graph in part c.; **or** a reasonable set of answers to the numerical calculations in parts a. and b., together with a bar graph in part c. that approximately represents these answers .
2	**Either** a reasonable set of answers to the numerical calculations in parts a. and b., with little significant progress on the bar graph in part c.; **or** an unreasonable set of answers to the numerical calculations in parts a. and b., together with a bar graph in part c. that approximately represents these answers.
1	A significant start to the solution of the problem. Examples of significant starts include, but are not limited to, showing a totalling process in part a., multiplying a difference in gasoline prices by 3 100 in part b., and displaying a set of numbers of dollars in a bar graph form.
0	**Either** off-topic; **or** a blank paper.

Continued

Communication Skills Scale

This scale is used **independently** of the *Mathematical Content* scale. A well-drawn, fully labelled graph can receive a scale score of 3, even if the graph itself is based on data that contain gross errors in the calculations of the supporting numbers.

Scale score	Criteria
3	A budget graph that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of graph drawing, axis labelling, and computation of the numbers have been generally respected.
2	A budget graph that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is some evidence that the reader has been taken into account. Conventions of graph drawing, axis labelling, and computation of the numbers have been respected only on an inconsistent basis.
1	An attempt has been made to communicate the budget, but the communication requires the reader to fill in many gaps in the drawing of the columns, the labelling of the axes, and the computation of the numbers. Generally difficult for the reader to understand.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Performance Assessment — Task 2
Student Responses

This response would receive a score of	**5**	for mathematical content	
and would receive a score of	**3**	for communication skills	

Scoring Criteria

Mathematical Content

- Complete and correct set of answers to parts a. and b., together with a bar graph in part c. that accurately represents these answers.

Communication Skills

- A budget graph that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of graph drawing, axis labelling, and computation of the numbers have been generally respected.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

Cost category	Costs incurred	
Depreciation	$2650.00	
Insurance and registration	$840.00	
Tires	4 at $72.50 each 29 0	
Oil changes	7 at $32.95 each 230.65	
Gasoline	3100 L at 44.9 cents/litre	1391.9
Repairs	$115.00 for a tune-up	
	$277.50 for brakes	
Parking	$44.50 per month for 12 months 534	
Washing	27 washes at $4.25 each 114.75	
Interest on borrowed money	$1145.00	

a. What was the total cost, to Roger, of running his car for the year?

$$2650 + 840 + 290 + 230.65 + 1391.9 + 115 + 277.5 +$$
$$534 + 114.75 + 1145 = \underline{7588.80}$$

b. If the price of gasoline increased to 61.5 cents/litre, how much **extra** would it cost Roger to run his car for the year?

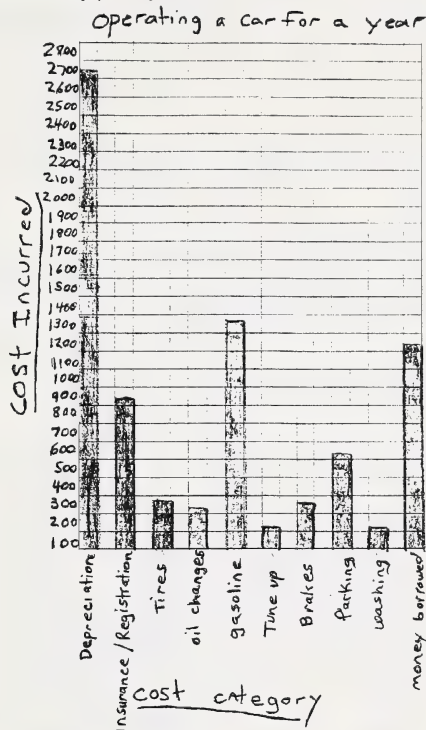$$61.5 \times 3100 = 1906.5$$
$$1906 5 - 1391.9 = \underline{514.6}$$

Continued

c. Display the budget as a graph.

Operating a car for a year

Commentary

This response receives a score of 5 for **mathematical content** *because the student*

- completes the calculations for each of the cost categories at the side of the table, and adds them correctly to reach the total of $7 588.80.
- modifies the data to allow for the increase in gasoline costs, and calculates the extra cost as $1 906.50 – $1 391.90, or $514.60.
- completes the bar graph, using ten categories and appropriate scales on the axes. The split of the repair costs into tune-up and brakes is reasonable.

This response receives a score of 3 for **communication skills** *because the student*

- shows all the calculations in sufficient detail that each entry can be checked without undue searching.
- draws the graph with full respect for all the conventions. Titles are provided for the full graph and for each one of the axes; scales are chosen so that the graph fills the page, and labelling is set out neatly so that long labels do not interfere with one another.

This response would receive a score of **4** *for mathematical content*
and would receive a score of **3** *or communication skills*

Scoring Criteria

Mathematical Content

- A reasonable set of answers to the numerical calculations in parts a. and b., together with a bar graph in part c. that exactly represents these answers.

Communication Skills

- A budget graph that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of graph drawing, axis labelling, and computation of the numbers have been generally respected.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

Cost category	Costs incurred
Depreciation	$2650.00
Insurance and registration	$840.00
Tires	4 at $72.50 each
Oil changes	7 at $32.95 each
Gasoline	3100 L at 44.9 cents/litre
Repairs	$115.00 for a tune-up
	$277.50 for brakes
Parking	$44.50 per month for 12 months
Washing	27 washes at $4.25 each
Interest on borrowed money	$1145.00

a. What was the total cost, to Roger, of running his car for the year?

$$2650.00$$
$$840.00$$
$$290.00$$
$$230.65$$
$$1391.90$$
$$115.00$$
$$277.50$$
$$534.00$$
$$114.75$$
$$1145.00 = \$7588.80$$

$$4 \times 72.50$$
$$7 \times 32.95 = 230$$
$$3100 \times 44.9 =$$
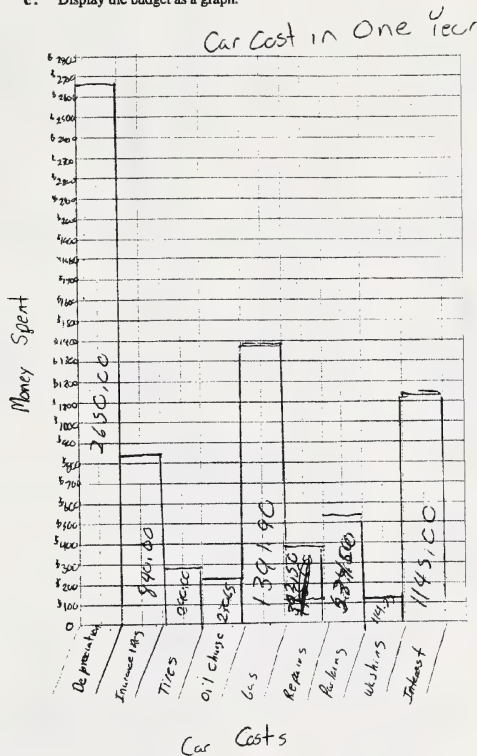
b. If the price of gasoline increased to 61.5 cents/litre, how much extra would it cost Roger to run his car for the year?

$$3100 \times 61.5 = 1906.50 \text{ gas}$$

$$7588.80 - 1391.90 = 6196.90$$

$$6196.40 + 1906.50 = \$8103.40$$

Continued

Continued

c. Display the budget as a graph.

Car Cost in One Year

Money Spent

Car Costs

Commentary

*This response receives a score of 4 for **mathematical content** because the student*

- completes the calculations for each of the cost categories at the side of the table, and adds them correctly to reach the total of $7 588.80.
- modifies the data to allow for the increase in gasoline costs and calculates the new gasoline cost as $1 906.50, but then calculates the new total cost, rather than the increase of cost The new total cost of $8 103.40 is correct, but the increase of $514.60 is not shown here.
- completes the bar graph, using the nine categories given and appropriate scales on the axes.

*This response receives a score of 3 for **communication skills** because the student*

- shows all the calculations in sufficient detail that each entry can be checked without undue searching.
- draws the graph with reasonable respect for all the conventions. Titles are provided for the full graph and for each of the axes; scales are chosen so that the graph fills the page, and labelling is set out for the most part so that long labels do not interfere with one another. The insertion of the dollar amounts, such as $2 650 in the depreciation column, makes the graph easier to read.

| This response would receive a score of | **4** | for mathematical content |
| and would receive a score of | **2** | for communication skills |

Scoring Criteria

Mathematical Content

- A complete and correct set of answers to parts a. and b., together with a bar graph in part c. that reasonably represents these answers.

Communication Skills

- A budget graph that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is some evidence that the reader has been taken into account. Conventions of graph drawing, axis labelling, and computation of the numbers have been respected only on an inconsistent basis.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

Cost category	Costs incurred	
Depreciation	$2650.00	
Insurance and registration	$840.00	
Tires	4 at $72.50 each	290
Oil changes	7 at $32.95 each	230.65
Gasoline	3100 L at 44.9 cents/litre	1391.90
Repairs	$115.00 for a tune-up	
	$277.50 for brakes	
Parking	$44.50 per month for 12 months	
Washing	27 washes at $4.25 each	114.75
Interest on borrowed money	$1145.00	

(Budget)

a. What was the total cost, to Roger, of running his car for the year?

$$2650.^{00} + 840.^{00} + 290.^{00} + 1391.90 + 115.^{00} + 277.50 + 44.50 \times 12 + 114.75 + 1145.^{00} = \$7,588.80$$
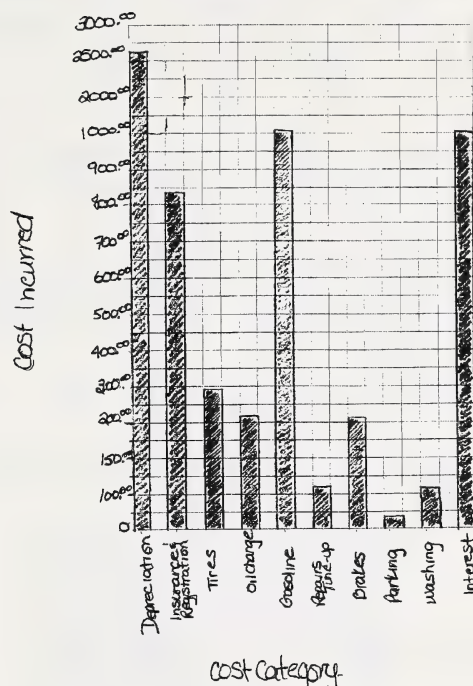
b. If the price of gasoline increased to 61.5 cents/litre, how much **extra** would it cost Roger to run his car for the year?

$$1906.50 - 1391.90 = \$514.60 \text{ more.}$$

Continued

Continued

c. Display the budget as a graph.

Commentary

This response receives a score of 4 for **mathematical content** *because the student*

- completes the calculations for each of the cost categories at the side of the table and adds them correctly to reach the total of $7 588.80.
- modifies the data to allow for the increase in gasoline costs, and calculates the extra cost as $1 906.50 – $1 391.90, or $514.60.
- completes the bar graph, using nine categories, and produces a graph that is approximately the right shape. However, the errors made in scaling the top part of the vertical axis, where successive scale points are labelled $900, $1 000, $2 000, $2 500, and $3 000 mean that the three main costs, depreciation, gasoline, and interest, are diminished in importance compared to the other six categories.

This response receives a score of 2 for **communication skills** *because the student*

- shows most of the calculations in sufficient detail that each entry can be checked without undue searching. The detail on the $1 906.50 for the new cost of gasoline is not included, although it easily could have been.
- draws the graph with reasonable respect for all the conventions. Titles are provided for each one of the axes, but not for the full graph; the graph fills the page and labelling is set out clearly, except for the omission of the dollar sign as a unit for the vertical axis.

This response would receive a score of	**3**	for mathematical content
and would receive a score of	**2**	for communication skills

Scoring Criteria

Mathematical Content

- A reasonable set of answers to the numerical calculations in parts a. and b., together with a bar graph in part c. that approximately represents these answers.

Communication Skills

- A budget graph that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is some evidence that the reader has been taken into account. Conventions of graph drawing, axis labelling, and computation of the numbers have been respected only on an inconsistent basis.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

Cost category	Costs incurred
Depreciation	$2650.00
Insurance and registration	$840.00
Tires	4 at $72.50 each
Oil changes	7 at $32.95 each
Gasoline	3100 L at 44.9 cents/litre
Repairs	$115.00 for a tune-up
	$277.50 for brakes
Parking	$44.50 per month for 12 months
Washing	27 washes at $4.25 each
Interest on borrowed money	$1145.00

a. What was the total cost, to Roger, of running his car for the year?

```
         2650.00
          840.00
Tires    290.00
0.1      230.65        6196.90
         115.00        - 69.04 Gas
         277.50     $ 6265.94
         534.00
       + 114.75  √
         1145.00
```
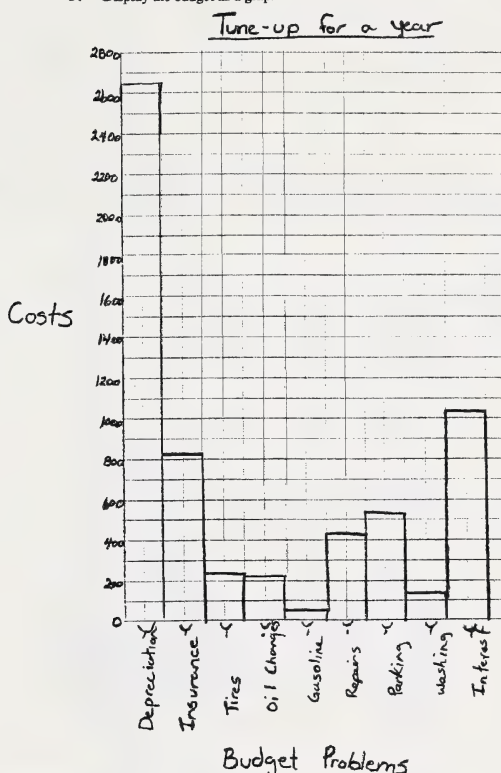
b. If the price of gasoline increased to 61.5 cents/litre, how much **extra** would it cost Roger to run his car for the year?

It would cost a extra $50.40 to run rogers car

61.5 ÷ 3100 = 350.40

Continued

c. Display the budget as a graph.

Tune-up for a year

Costs

Budget Problems

Commentary

This response receives a score of 3 for **mathematical content** *because the student*

- completes all the calculations correctly, except for the gasoline cost. Here the student divided 3 100 by 44.9 to obtain a yearly gasoline cost of $69.04, which is unreasonable, since it represents approximately three fills of the tank. This incorrect process is repeated when the gasoline cost is recalculated in the second part.
- completes the bar graph, using the nine categories given, and appropriate scales on the axes. The graph is an accurate representation of the calculated figures.

This response receives a score of 2 for **communication skills** *because the student*

- shows most of the details of the computation of the various category costs, with the exception of the division method used for computation of the gasoline costs. No division was indicated in either part a. or part b.
- produces a bar graph that is clear and easy to read, with appropriate scaling and labelling of the axes. The main title "Tune-up for a Year" is somewhat misleading, and dollar signs are needed to indicate the unit on the vertical axis.

This response would receive a score of **2** for mathematical content
and would receive a score of **1** for communication skills

Scoring Criteria

Mathematical Content

- A reasonable set of answers to the numerical calculations in parts a. and b., with little significant progress on the bar graph in part c.

Communication Skills

- An attempt has been made to communicate the budget, but the communication requires the reader to fill in many gaps in the drawing of the columns, the labelling of the axes, and the computation of the numbers. Generally difficult for the reader to understand.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:

| Cost category	Costs incurred
Depreciation	$2650.00
Insurance and registration	$840.00
Tires	4 at $72.50 each
Oil changes	7 at $32.95 each
Gasoline	3100 L at 44.9 cents/litre
Repairs	$115.00 for a tune-up
	$277.50 for brakes
Parking	$44.50 per month for 12 months
Washing	27 washes at $4.25 each
Interest on borrowed money	$1145.00

a. What was the total cost, to Roger, of running his car for the year?

$2650.00 + 840 + 290 + 230.65 + 69.04 + 1392.50 + 44.50$
$+ 114.75 + 1145.00 \approx 5776.44$

b. If the price of gasoline increased to 61.5 cents/litre, how much extra would it cost Roger to run his car for the year? $61.5 \times 44.9 \approx 2761.35$

Continued

Continued
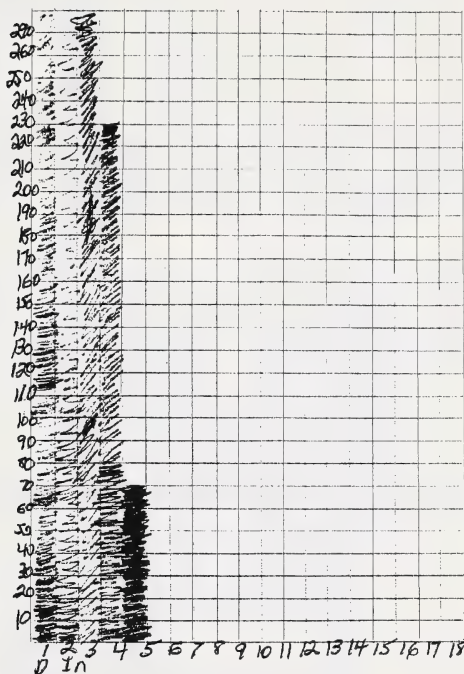
c. Display the budget as a graph.

Commentary

*This response receives a score of 2 for **mathematical content** because the student*

- calculates all costs correctly except for the gasoline costs. The gasoline cost of 69.04 (3 100 divided by 44.9) in the first part, or $2 761.35 (61.5 multiplied by 44.9) are both unreasonable, especially the first one; however, the total cost for running the car for the year of $5 776.44 is reasonably accurate for a compact car.

- starts on a graph, but uses an inappropriate scale of 1 square for $10 on the vertical axis, while the labels and variables on the horizontal axis are not defined at all.

*This response receives a score of 1 for **communication skills** because the student*

- provides no details for any of the numbers in the first part, leaving the reader to find out where numbers like 290, or 230.65, or 69.094392 come from.

- does not follow any conventions in the drawing of the bar graph; scales are inappropriate on the vertical axis, and labels are not present with for the horizontal axis or for the complete graph.

This response would receive a score of **1** for mathematical content
and would receive a score of **2** for communication skills

Scoring Criteria

Mathematical Content

- A significant start on the problem. Examples of significant starts include, but are not limited to, showing a totalling process in part a., multiplying a difference in gasoline prices by 3 100 in part b., and displaying a set of numbers of dollars in a bar graph form.

Communication Skills

- A budget graph that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is some evidence that the reader has been taken into account. Conventions of graph drawing, axis labelling, and computation of the numbers have been respected only on an inconsistent basis.

Task 2: Operating a Car for a Year

Roger kept good records of the costs of running his 1993 compact car for the calendar year 1995. He found the following costs:
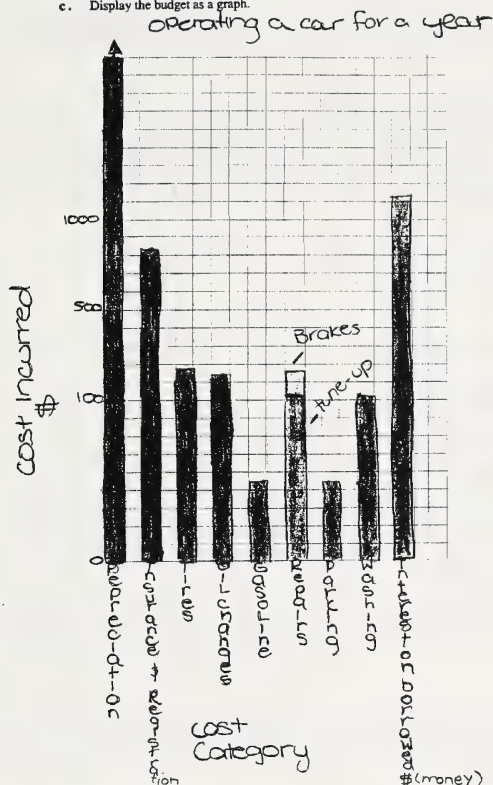
Cost category	Costs incurred
Depreciation	$2650.00
Insurance and registration	$840.00
Tires	4 at $72.50 each $290.00
Oil changes	7 at $32.95 each $230.65
Gasoline	3100 L at 44.9 cents/litre
Repairs	$115.00 for a tune-up $277.50 for brakes
Parking	$44.50 per month for 12 months
Washing	27 washes at $4.25 each $113.40
Interest on borrowed money	$1145.00

a. What was the total cost, to Roger, of running his car for the year?

2650 + 840 + 72.50×4 + 7× 3295 + 449 +
115 + 277.50 + 44.50 + 4.25× 27 + 1145
$19 1382.60

b. If the price of gasoline increased to 61.5 cents/litre, how much **extra** would it cost Roger to run his car for the year?

total would be $19 1399.20
extra = 16.60

Continued

Continued

c. Display the budget as a graph.

operating a car for a year

Cost Category

This graph is a hand-drawn bar graph titled "operating a car for a year." The vertical axis is labelled "cost incurred $" with markings at 0, 100, 500, and 1000. The horizontal axis is labelled "cost category" with bars labelled: depreciation, insurance & registration, tires, oil changes, gasoline, repairs, parking, washing, interest on borrowed $(money). Labels "Brakes" and "Tune-up" point to portions of the repairs bar.

Commentary

*This response receives a score of 1 for **mathematical content** because the student*

- calculates correctly the cost of the 4 tires and the 7 oil changes, and calculates approximately the cost of the 27 washes ($113.40 instead of the accurate $114.75).
- combines the costs using a four-function calculator, does not allow for the order of operations, and ends up with an answer ($191 382.60) that is very much higher than the true cost of $7 588.80.

*This response receives a score of 2 for **communication skills** because the student*

- shows most of the calculations in sufficient detail that each entry can be checked without undue searching. However, the detail regarding the extra cost of gasoline is not included, and easily could have been.
- draws the graph with reasonable respect for all the conventions. Titles are provided for each of the axes but not for the full graph; the graph fills the page, and labelling is set out clearly, including the dollar sign as a unit for the vertical axis.

Task 3: House Floor Plans
Student Task and Solution

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.

Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people

a. What would be reasonable for the length and the width of the two- car garage?

Solution

7 m by 6 m. Other than 6 m by 7 m, there are few others that involve whole numbers of metres for length and width

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?

Solution

One possibility would be 8 m by 5 m for the master bedroom, and 5 m by 4 m for each of the other two bedrooms.
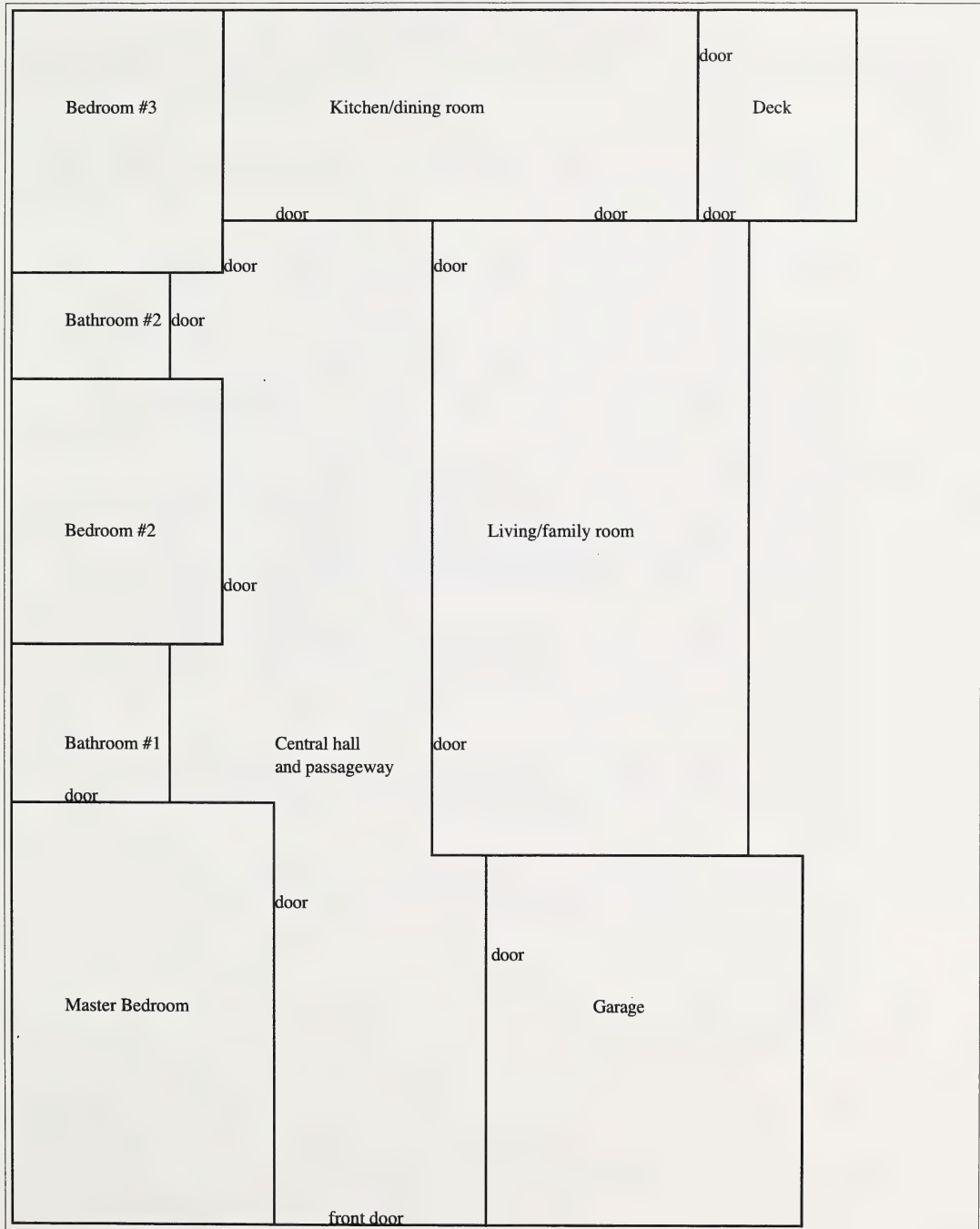
Here the number of possibilities is enormous, even including the convenient restriction of whole numbers for length and width.

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 unit = 1 m in your plan. Your plan, which must be to scale, **must** include all doors and hallways, and provide **at least two** entrances to the house, one from the front and one through the garage. The garage **must** be attached to the house.

Note: The scale of 1 square = 1 m used in the pilot has been changed to 1 unit = 1 m.

Solution

Grid Scale 1 unit = 1 m

Task-Specific Scoring Criteria for Task 3

Mathematical Content Scale

Scale score	Criteria
5	A house plan that incorporates **all** the design criteria asked for in the table, together with appropriate supporting calculations. The design should not have any obvious flaws.
4	**Either** a house plan that incorporates **most** of the design criteria asked for in the table, together with appropriate supporting calculations. The design should not have any obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws; **or** a house plan that incorporates **all** the design criteria asked for in the table, together with appropriate supporting calculations. The design may have one obvious flaw, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.
3	**Either** a house plan that incorporates **some** of the design criteria asked for in the table, together with appropriate supporting calculations. The design should not have any obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws; **or** a house plan that incorporates **most** of the design criteria asked for in the table, together with appropriate supporting calculations. The design may have one or two obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.
2	A house plan that incorporates **some** of the design criteria asked for in the table, with or without appropriate supporting calculations. The design may have some obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.
1	A significant start on the problem. Examples of significant starts include, but are not limited to, determining the dimensions of one or more rooms, placing one or more rooms on the house plan, and attaching the garage to the outside perimeter of the house.
0	**Either** off-topic; **or** a blank paper.

Continued

Mathematics 24 – Continued

Communication Skills Scale

This scale is used **independently** of the *Mathematical Content* scale. A well-drawn, fully labelled drawing can receive a scale score of 3, even if the design itself has major flaws, such as a garage that is 21 m by 2 m and not attached to the house.

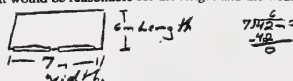| Scale score	Criteria
3	A house design plan that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of scale drawing have been generally respected.
2	A house design plan that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is little evidence that the reader has been taken into account. Conventions of scale drawing have been respected only on an inconsistent basis.
1	An attempt has been made to communicate the design, but the communication requires the reader to fill in many gaps in the drawing and the labelling. Generally difficult for the reader to understand.
0	**Either** insufficient evidence of communication skills; **or** a blank paper.

Performance Assessment — Task 3
Student Responses

This response would receive a score of	**5**	*for mathematical content*
and would receive a score of	**3**	*for communication skills*

Scoring Criteria

Mathematical Skills

- A house plan that incorporates **all** the design criteria asked for in the table, together with appropriate supporting calculations. The design should not have any obvious flaws.

Communication Skills

- A house design plan that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of scale drawing have been generally respected.

Task 3: House Floor Plans

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.
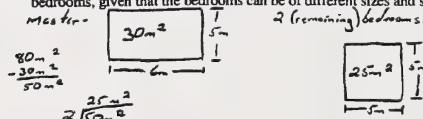
Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people

a. What would be reasonable for the length and the width of the two- car garage?

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?
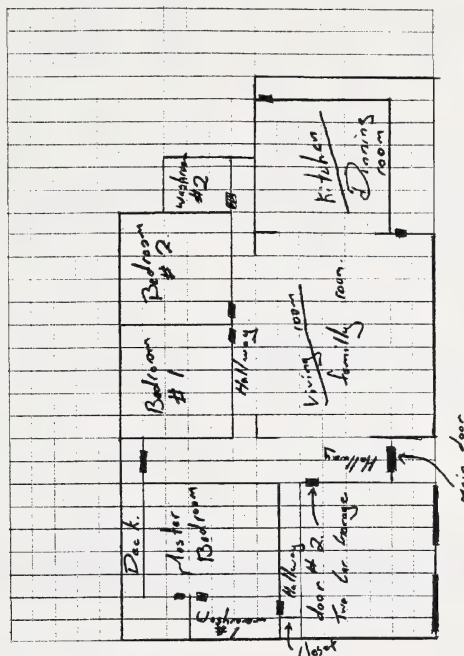

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 square = 1 m in your plan. Your plan, which must be to scale, **must** include all doors and hallways, and provide **at least two** entrances to the house, one from the front and one through the garage. The garage **must be** attached to the house.

Continued

Grid Scale   1 square = 1 m

Commentary

*This response receives a score of 5 for **mathematical content** because the student*

- makes sure that all the design criteria are complied with, in particular the length and the width of the garage and the bedrooms. The garage possibly should be 7 m long and 6 m wide, but, as most cars are less than 6 m long, a garage that is 6 m long and 7 m wide still works as a garage.
- ensures that every room in the diagram is drawn to scale, and that all doors and hallways are marked on the plans.
- includes a deck, not called for by the criteria, to provide extra value to the house plan.

*This response receives a score of 3 for **communication skills** because the student*

- draws all parts of the plan to scale, sticks to the scale, and labels all rooms as required.
- includes most labels required for doors and hallways.

This response would receive a score of	**4**	for mathematical content	
and would receive a score of	**2**	for communication skills	

Scoring Criteria

Mathematical Content

- A house plan that incorporates **all** the design criteria asked for in the table, together with appropriate supporting calculations. The design may have one obvious flaw, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.

Communication Skills

- A house design plan that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is little evidence that the reader has been taken into account. Conventions of scale drawing have been respected only on an inconsistent basis.

Task 3: House Floor Plans

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.

Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people

a. What would be reasonable for the length and the width of the two- car garage?

$6 \times 7 = 42$ 6.m by 7   6 metre at the front 7 deed

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?
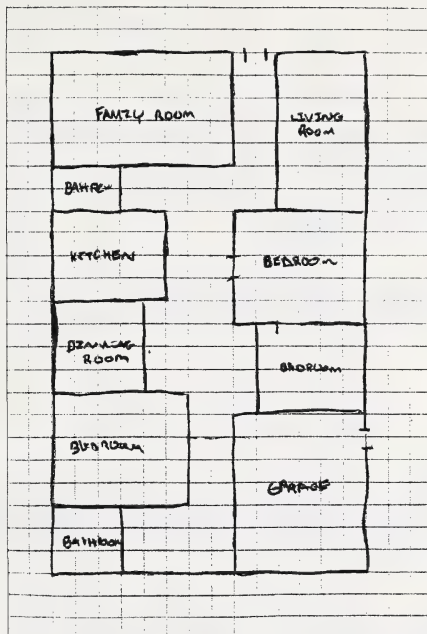
1. 5×6 2. $5 \times 6 = 4 \times 5$
   $30 m^2$ $30 m^2$ $20 m^2$

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 square = 1 m in your plan. Your plan, which must be to scale, **must** include all doors and hallways, and provide at least **two** entrances to the house, one from the front and one through the garage. The garage **must** be attached to the house.

Continued

Grid Scale   1 square = 1 m

Commentary

This response receives a score of 4 for **mathematical content** *because the student*

- makes sure that all the design criteria are complied with, in particular the length and the width of the garage and the bedrooms. The garage possibly should be 7 m long and 6 m wide, but, as most cars are less than 6 m long, a garage that is 6 m long and 7 m wide still works as a garage.
- ensures that every room in the diagram is drawn to scale, and that all doors and hallways are marked on the plans.
- does not include the appropriate doors, and has a hallway that splits the house into two parts.

This response receives a score of 2 for **communication skills** *because the student*

- draws all parts of the plan to scale, sticks to the scale, and labels all rooms as required.
- omits some of the labels that are required for doors and hallways, leaving this part of the labelling to the reader.

This response would receive a score of **3** *for mathematical content*
and would receive a score of **3** *for communication skills*

Scoring Criteria

Mathematical Content

- A house plan that incorporates **most** of the design criteria asked for in the table, together with appropriate supporting calculations. The design may have one or two obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.

Communication Skills

- A house design plan that is clearly drawn and fully labelled. There is evidence that the reader has been taken into account, and that the conventions of scale drawing have been generally respected.

Task 3: House Floor Plans

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.

Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people

a. What would be reasonable for the length and the width of the two-car garage?
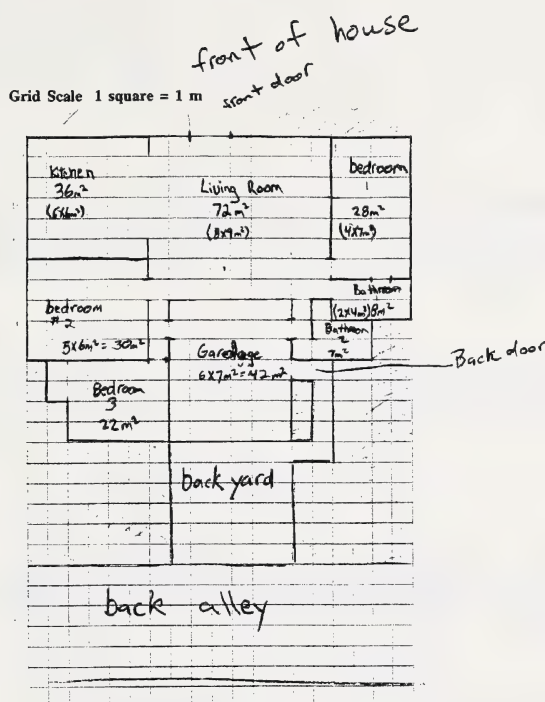
   a 6x7m² garoage is resonable

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?

   around 30m² would be a resonable bedroom size

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 square = 1 m in your plan. Your plan, which must be to scale, **must** include all doors and hallways, and provide at **least two** entrances to the house, one from the front and one through the garage. The garage **must** be attached to the house.

Continued

Continued

front of house

Grid Scale 1 square = 1 m   front door

kitchen 36m² (6×6m²)	Living Room 72m² (8×9m²)	bedroom 28m² (4×7m²)

bedroom #2   5×6m² = 30m²

Bedroom 3   22m²

Garage 6×7m² = 42m²

Bathroom (2×4m²)8m²
Bathroom 2   7m²

Back door

back yard

back alley

Commentary

This response receives a score of 3 for **mathematical content** *because the student*

- provides dimensions for the garage, but not for each bedroom.
- has both bathrooms next to each other, rather than close to the appropriate bedrooms or living areas.
- has the garage in too central a position, thereby requiring traffic through the house to go around, in, or through the garage.

This response receives a score of 3 for **communication skills** *because the student*

- draws all parts of the plan to scale, sticks to the scale, and labels all parts as required.
- respects the reader by stating the dimensions of each room, thus saving the reader the trouble of counting the squares to find the dimensions.

This response would receive a score of **2** for mathematical content
and would receive a score of **2** for communication skills

Scoring Criteria

Mathematical Content

- A house plan that incorporates **some** of the design criteria asked for in the table, with or without appropriate supporting calculations. The design may have some obvious flaws, such as a garage that cannot fit two cars, insufficient hallway space, bathrooms that are attached to the garage, or other similar flaws.

Communication Skills

- A house design plan that is drawn and labelled. Drawings may lack clarity and may be missing some labelling. There is little evidence that the reader has been taken into account. Conventions of scale drawing have been respected only on an inconsistent basis.

Task 3: House Floor Plans

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.

Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	20,25,35 80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people 1m 2m

a. What would be reasonable for the length and the width of the two-car garage?

18×24

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?

one room 20 m² 5×4
one room 25 m² 5×5
one room 35 m² 7×5

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 square = 1 m in your plan. Your plan, which must be to scale, must include all doors and hallways, and provide at least two entrances to the house, one from the front and one through the garage. The garage must be attached to the house.

Continued

Continued

Grid Scale 1 square = 1 m
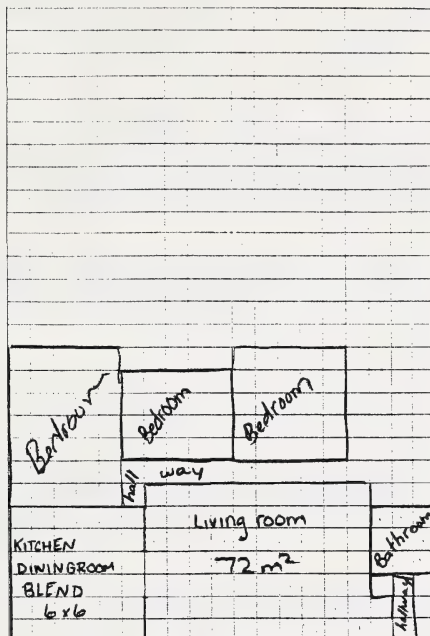
Commentary

This response receives a score of 2 for **mathematical content** *because the student*

- provides reasonable dimensions for the bedrooms, but confuses the area of the garage with its half-perimeter. An area of 42 m² is needed for the garage, not a sum of 42 m for the length and the width.
- incorporates only the bedrooms, the kitchen/dining room and the living room into the plan, together with one of the bathrooms. The garage and the second bathroom are not included, and the design has only a single entrance/exit.

This response receives a score of 2 for **communication skills** *because the student*

- does generally keep to the scale, although the reader has to measure each of the rooms in order to verify that the plans are being adhered to.
- does not show where the doors are as part of the labelling.

Scoring Criteria

Mathematical Content

- A significant start on the problem. Examples of significant starts include, but are not limited to, determining the dimensions of one or more rooms, placing one or more rooms on the house plan, and attaching the garage to the outside perimeter of the house.

Communication Skills

- An attempt has been made to communicate the design, but the communication requires the reader to fill in many gaps in the drawing and the labelling. Generally difficult for the reader to understand.

Task 3: House Floor Plans

You have won $200 000 in a lottery and decide to build a house. Because your grandfather will be coming to live with you, you decide to build a house on one level. The city council does not allow any basements, so there are no stairs in the house at all. There must be sufficient hallways and passages to allow for the easy movement of people through the house.

Make your house plan with main floor rooms of the following areas:

Room or area on main floor	Total area in square metres
Kitchen/dining room	36
Living/family room	72
2 bathrooms	15 in total
3 bedrooms	80 in total
Two-car garage	42
Hallways and passages	sufficient for easy movement of people

a. What would be reasonable for the length and the width of the two- car garage?

b. What could be reasonable for the length and the width of each of the three bedrooms, given that the bedrooms can be of different sizes and shapes?

c. Draw an accurate house plan, using either one of the grids on the next two pages. Use a scale of 1 square = 1 m in your plan. Your plan, which must be to scale, **must** include all doors and hallways, and provide **at least two** entrances to the house, one from the front and one through the garage. The garage **must** be attached to the house.

Continued

Continued

Grid Scale 1 square = 1 m

(If you have made mistakes, there is another grid on the next page)

$$5 \times 5$$
$$5 \times 5$$
$$4 \times 6$$

Commentary

This response receives a score of 1 for **mathematical content** *because the student*

- puts information directly on to the drawing without attempting to answer either of the first two preliminary parts.
- shows the correct dimensions for the living room and reasonable dimensions for two of the bedrooms.
- omits to satisfy any of the other criteria included in the house design.
- confuses the house and the lot, as the plan shows the rooms spread around the outside of the lot.

This response receives a score of 1 for **communication skills** *because the student*

- incorporates rooms into the house plan, and three of the rooms (living room and two bedrooms) are correctly labelled.
- omits many of the labels, in particular the garage, the doors, and the hallways.